This is a digital copy of a book that was preserved for generations on library shelves before it was carefully scanned by Google as part of a project to make the world's books discoverable online.

It has survived long enough for the copyright to expire and the book to enter the public domain. A public domain book is one that was never subject to copyright or whose legal copyright term has expired. Whether a book is in the public domain may vary country to country. Public domain books are our gateways to the past, representing a wealth of history, culture and knowledge that's often difficult to discover.

Marks, notations and other marginalia present in the original volume will appear in this file - a reminder of this book's long journey from the publisher to a library and finally to you.

Usage guidelines

Google is proud to partner with libraries to digitize public domain materials and make them widely accessible. Public domain books belong to the public and we are merely their custodians. Nevertheless, this work is expensive, so in order to keep providing this resource, we have taken steps to prevent abuse by commercial parties, including placing technical restrictions on automated querying.

We also ask that you:

+ *Make non-commercial use of the files* We designed Google Book Search for use by individuals, and we request that you use these files for personal, non-commercial purposes.

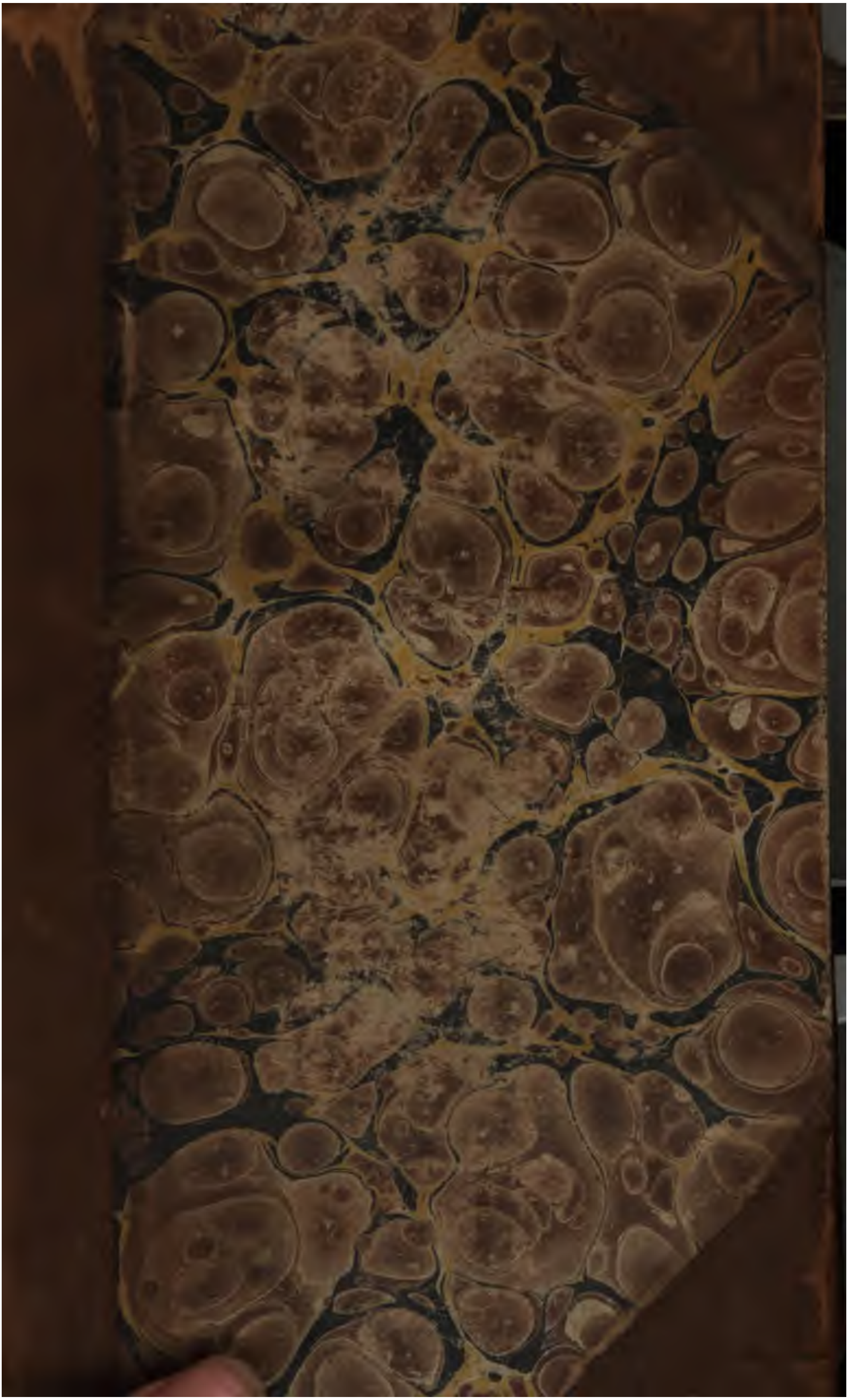
+ *Refrain from automated querying* Do not send automated queries of any sort to Google's system: If you are conducting research on machine translation, optical character recognition or other areas where access to a large amount of text is helpful, please contact us. We encourage the use of public domain materials for these purposes and may be able to help.

+ *Maintain attribution* The Google "watermark" you see on each file is essential for informing people about this project and helping them find additional materials through Google Book Search. Please do not remove it.

+ *Keep it legal* Whatever your use, remember that you are responsible for ensuring that what you are doing is legal. Do not assume that just because we believe a book is in the public domain for users in the United States, that the work is also in the public domain for users in other countries. Whether a book is still in copyright varies from country to country, and we can't offer guidance on whether any specific use of any specific book is allowed. Please do not assume that a book's appearance in Google Book Search means it can be used in any manner anywhere in the world. Copyright infringement liability can be quite severe.

About Google Book Search

Google's mission is to organize the world's information and to make it universally accessible and useful. Google Book Search helps readers discover the world's books while helping authors and publishers reach new audiences. You can search through the full text of this book on the web at `http://books.google.com/`



600006427P

31.

319.

600006427P

31.
319.

PRACTICAL REMARKS

ON THE

NATURE AND TREATMENT

OF

FRACTURES

OF THE

TRUNK AND EXTREMITIES;

BEING THE SUBSTANCE OF THAT PORTION OF HIS

LECTURES

WHICH RELATES TO THIS SUBJECT.

ILLUSTRATED BY PLATES, WOOD-CUTS, AND CASES.

By JOSEPH AMESBURY,
SURGEON,
FELLOW OF VARIOUS LEARNED AND SCIENTIFIC SOCIETIES.

VOL. II.

LONDON:
LONGMAN, REES, ORME, BROWN AND GREEN,
PATERNOSTER ROW,
AND MAY BE HAD OF ALL BOOKSELLERS.
MDCCCXXXI.

319.

BIBLIOTHECA·BODLEIANA·

PRINTED BY G. HAYDEN,
Little College Street, Westminster.

CONTENTS.

CHAP. V.

SIMPLE FRACTURES OF THE LEG.

Page

SEC. 1.—Causes, Nature, and Symptoms of Simple Fractures of the Leg 385

SEC. 2.—Common Modes of Treating Simple Fractures of the Leg 392

SEC. 3.—The Author's Mode of Treating Simple Fractures of the Leg 414

SEC. 4.—Fractures of the Bones of the Leg, accompanied with Dislocation of the Base of the Tibia, commonly called Dislocation of the Ancle-joint.. 453

SEC. 5.—Common Modes of Treating Simple Dislocations of the Ancle-joint 462

SEC. 6.—The Author's Plan of Treating Simple Dislocations of the Ancle-joint 470

CHAP. VI.

FRACTURES OF THE PATELLA.

SEC. 1.—Causes, Nature, and Symptoms of Fractures of the Patella 479

SEC. 2.—Common Modes of Treating Fractures of the Patella 483

SEC. 3.—The Author's Mode of Treating Fractures of the Patella 492

CHAP. VII.

FRACTURES OF THE CLAVICLE.

Page
SEC. 1.—Causes, Nature, and Symptoms of Fractures of the Clavicle 500
SEC. 2.—The usual Modes of Treatment 506
SEC. 3.—Author's Mode of Treatment 513

CHAP. VIII.

FRACTURES OF THE SCAPULA .. .. [illegible]

CHAP. IX.

FRACTURES OF THE HUMERUS.

SEC. 1.—Causes, Nature, and Symptoms 535
SEC. 2.—The usual Mode of Treating Fractures of the Humerus 543
SEC. 3.—The Author's Treatment of Fractures of the Humerus 553

CHAP. X.

FRACTURES OF THE FORE-ARM.

SEC. 1.—Fractures of the Olecranon—Causes, Nature and Symptoms 568
SEC. 2.—The usual Modes of Treating Fractures of the Olecranon. 572
SEC. 3.—The Author's T[illegible]of Fractures of the Olecranon 576
SEC. 4.—Fractures of the Coronoid Process of the Ulna 583

Page
SEC. 5.—Fractures of the Body of the Ulna, and Fractures of the Radius, singly and together—Causes, Nature, and Symptoms 586
SEC. 6.—The usual Modes of Treating Fractures of the Bodies of the Ulna and Radius 595
SEC. 7.—The Author's Mode of Treating Fractures of the Fore-arm 598

CHAP. XI.

FRACTURES OF THE RIBS—CAUSES, SYMPTOMS, NATURE AND TREATMENT 607

CHAP. XII.

INJURIES OF THE SPINAL COLUMN AND SPINAL CHORD 614
Fractures of the Spine.. 615

CHAP. XIII.

FRACTURES OF THE PELVIS.. 632

CHAP. XIV.

COMPOUND FRACTURES.

SEC. 1.—The Nature of Compound Fracture—The usual Modes of Treatment—Local—Constitutional.. 638
SEC. 2.—The Author's Treatment in Compound Fractures 669
SEC. 3.—Compound Dislocations of the Ancle.. .. 697

CHAP. XV.

FRACTURES OF LONG STANDING.

Page

SEC. 1.—The Causes and Nature of Fractures of Long Standing 710

SEC. 2.—The usual Modes of Treating Fractures of Long Standing, with Cases and Observations 725

SEC. 3.—The Plans of Treatment which the Author has found most successful; with Cases and Observations.. 743

Influence of Local Pressure and Rest in the Treatment of Fractures of Long Standing in the Humerus 753

Influence of Local Pressure and Rest in the Treatment of Fractures of Long Standing in the Fore-arm.. 767

Influence of Local Pressure and Rest in the Treatment of Fractures of Long Standing in the Femur.. .. .. [illegible]

Influence of Local Pressure and Rest in the Treatment of Fractures of Long Standing in the Leg.. 790

Treatment of Fractures of Long Standing, which do not admit of being united by the Influence of Pressure and Rest alone.. 808

ON THE

NATURE AND TREATMENT

OF

FRACTURES.

PARTICULAR FRACTURES CONTINUED.

CHAP. V.

Simple Fractures of the Leg.

WE are now come to the consideration of another important class of accidents, *viz.*, fractures of the bones of the leg. Fractures of these bones are probably far more frequent than similar injuries in any other part of the body. In themselves they are simple accidents, and when properly managed, are easily brought to a favourable termination; but, as they are commonly treated, they are frequently followed with much deformity and lameness. The causes of these evils, I shall endeavour to explain as I proceed, and, I hope I shall be enabled to express myself, so as to be rightly understood by all those who feel an interest in the subject, and whose business it is to study the management of these, in common with all other accidents, that they may not injure their patients by ignorance, nor be instrumental in destroying their own reputation.

Sec. 1.—*Causes, Nature, and Symptoms, of Simple Fractures of the Leg.*

Bones of the leg.

There are two bones in the leg. The tibia or larger bone is articulated to the femur, and forms with it a hinge-like joint. The same kind of joint is formed where this bone is connected to the bones of the foot; but the fibula, placed at the outer side of the tibia, assists in the formation of the ancle-joint.

Fractured at any part.

Fractures of the bones of the leg may occur at any part, and in one or more situations. When both bones are broken, the fracture of one may be situated at a considerable distance from that of the other. The fractures may be transverse, oblique, or comminuted; they may be attended with little or much laceration of the surrounding parts.

Causes.

The causes of fracture of the bones of the leg are blows, falls, the passage of heavy bodies over the leg, twists of the foot, &c.

Symptoms of fracture of the fibula.

Fractures of the small bone are most commonly produced by a violent twist of the foot; but they are often occasioned, also, by a blow upon the outer side of the leg. When the bone is broken, with but little laceration of the soft parts, the fractured ends are sometimes held so firmly together, as to require rather a practised hand to discover the existence of the fracture. Generally, however, there is no difficulty experienced. Preternatural motion and crepitus become evident, by rolling the foot rather strongly upon the tibia, or by abducting, adducting, flexing, or bending it; also, by pressing the fibula towards the side of the tibia, or backward or forward. The fractured ends are usually drawn a little towards the tibia. The patient can stand upon the limb generally, and frequently walk; not, however, without feeling a sensation of weakness and pain in the situation of the fracture.

Of the tibia.

Fractures of the large bone of the leg are for the most part easily discovered. Yielding and crepitus are commonly perceived when any forcible attempt is made to bend the bone, and generally when the upper part of the bone is fixed, and the foot is at the same time forcibly rotated. When the fracture is unattended with any considerable laceration, crepitus is not always easily elicited.

Fractures of the head of.

Sometimes a portion of the head of the tibia is split off obliquely into the knee-joint, in a direction downward and outward, or downward and inward. This variety may be easily ascertained, by abducting and adducting the leg while the thigh is fixed. When an oblique fracture of this description exists, an angle will be formed at the outer or inner side of the knee, when the leg is moved laterally upon the femur. If the fracture divides the inner half of the head of the bone from the shaft, an angle projecting outward will be produced, by adducting the leg; and, if the outer half be separated, an angle may be formed projecting to the inner side, when the leg is abducted, though this would probably not be in so great a degree unless the fibula also be broken. In order that these symptoms might be rendered evident, it is necessary to hold the limb in the extended position. The scientific surgeon will be able to distinguish a fracture of this kind, from a fracture separating one of the condyles from the shaft of the femur, by the independent motion of the separated portion, which he will perceive, by grasping the head of the tibia, while the leg is being moved from side to side.

Both bones.

When both bones are broken, the symptoms are always very evident. Preternatural motion and crepitus, and more or less displacement, can always be readily produced, by a slight examination of the parts.

Situation.

The most common situation of fracture in the bones of the leg is just above the ancle, where the bones are smallest. When the fracture happens in consequence of a violent twist of the foot, which is a very common cause, the fibula is generally broken about two inches and a half above the point of the malleolus; and, if both bones are broken, the fracture of the tibia is usually through the base, and frequently oblique.

Displacement.

The displacement which is observed in fractures of the leg varies according to the situation and direction of the fracture and the degree of laceration of the surrounding parts which accompanies it. When only one of the bones is broken, the displacement in the longitudinal direction can be but slight, but it is sometimes considerable in the transverse.

isplacement
the tibia.

In a transverse fracture of the tibia, if there be any displacement, it is almost always slight; but when the bone is divided obliquely, and the fracture is of the loose kind, the broken ends are generally forced into unnatural positions. When the fracture extends downward and inward, the broken extremity of the lower portion is commonly displaced outward towards the fibula; when it runs through the bone downward and backward, the fractured end of the lower portion projects forward, and often threatens to come through the skin; when downward and forward, the fractured end of the upper portion projects forward; and when downward and outward, the limb commonly appears bent at the seat of fracture, both fractured ends being drawn towards the fibula. When a portion of the head of the bone is separated by a fracture running downward and outward, or downward and inward, it becomes displaced downward, nearly in the direction of the long diameter of the bone; but this will vary of course in different cases, in some instances according as the broken piece may happen to be influenced by the action of muscles attached to it, and other circumstances attending the fracture.

Of the fibula.

When the malleolus of the fibula is broken off, it sometimes becomes displaced backward; this is also the case with respect to the fractured end of the upper portion, when a fracture happens near to the head of the fibula. When the fracture is in any part of the body of the bone, at a little distance from either extremity, the broken ends generally approach the tibia, and one of them often lies behind the other.

Of both bones

The situation of the fractured extremities, with respect to each other, when both bones are broken, is for the most part the same as when only one is divided, but the displacement which occurs is commonly much more extensive. In transverse fracture, the displacement is generally angular, and usually accompanied with a twist of the lower portion, producing eversion or inversion of the foot. When the fracture is oblique, the displacement is usually of that description which I have called transverse, longitudinal, and angular, accompanied with eversion or inversion of the foot. Of all the oblique fractures of the body of the tibia, when the fibula is also broken, the most difficult to treat, by the common means, is that which divides the bone in a direction downward and backward. The cause of this difficulty is the action of the extensors of the foot, by which the foot is drawn backward, and the point of the fractured end of the lower portion is forced upward and forward against the integuments in front of the leg. This direction of the fracture is, however, of rare occurrence; and though the difficulty of managing it by any of the contrivances usually adopted, is such, that great deformity can scarcely be avoided, I find that it is easily controlled by the plan of treatment of which I shall presently have occasion to treat.

SEC. 2.—*Common Mode of Treating Simple Fractures of the Leg.*

[illegible]

When the fractured ends are carefully adjusted, the grand objects to be attained, in the treatment of all fractures, are to keep them in accurate apposition, and to prevent them from moving upon each other. In order to accomplish these purposes in the management of simple fractures of the leg, with the greatest security and advantage to the patient, it is proper to adopt such mechanical means as will enable us to answer the following indications: 1st. To fix the knee and ancle-joints. 2d. To prevent eversion or inversion of the foot. 3d. To support the heel. 4th. To support the sole of the foot. 5th. To keep up extension and counter-extension if necessary. 6th. To prevent transverse displacement whatever be the situation or course of the fracture. 7th. To keep the fractured ends from independent motion upon one another, when the trunk is moved, or passive motion is given to the limb.

Now let us investigate the usual modes of treating fractures of the leg, in order to see how far they tend to answer the indications which have been pointed out.

Common means.

The mechanical means commonly employed are split-deal splints, junks of different lengths, Sharp's splints, and Asilini's trough; and various modifications of these contrivances have been tried from time to time, but I am not aware that they are in any way superior in effect to those which I have mentioned.

Split-deal splints.

Split-deal splints of a length only sufficient to reach from the knee to the ancle, operate upon fractured bones much in the same manner as short junks *(Fig. a)*. The direct

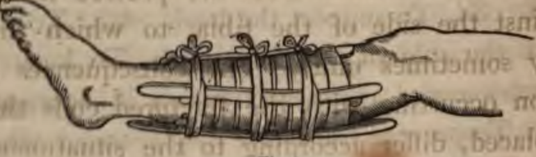


Fig. a.

tendency of both these plans of treatment, neither of which is very often resorted to, is to produce an approximation of the sides of the tibia and fibula, and thus to assist the muscles in producing deformity of the limb. The split-deal splints and short junks steady the fractured parts a little, but do not answer effectually any one of the indications above-mentioned. This will be rendered evident by considering the position of the bones of the leg with respect to one another. Every one who knows any thing of anatomy, is aware that these bones are in contact only at the ends, where they are joined together laterally in a manner which I need not describe. The bodies of the bones, in a natural state, are separated considerably from each other, hence it will appear that when one or both bones are broken through the bodies, these splints, which act as a broad ligature placed firmly round the leg, must have the effect of causing the bones to approach each other in the lateral direction. If the fibula only is fractured, the fractured ends are pressed inward against the side of the tibia, to which they may sometimes unite. The consequences of union occurring with the fractured ends thus displaced, differ according to the situation of the fracture. When the fracture is situated near the middle of the bone, the limb appears unnaturally bent and flattened on the outer side, but when it is near the lower end, the foot has the appearance of being somewhat displaced outward; when the short splints or the short junks are used in the treatment of fractures of the tibia, the broken ends of the bone are likely to be forced outward, so as to produce the appearance of a bend in the bone at the seat of fracture.

The approximation of the fractured ends of the fibula towards the tibia, or of the tibia towards the fibula, when only one bone is broken, is generally accompanied with more or less inclination of the lower portion of the fractured bone out of its natural line, either forward or backward. This arises from the position in which the foot is suffered to remain during the uniting process. The weakeness and lameness which follow these simple accidents, when they are not well managed, is sometimes considerable and of long duration.

Case.

I was yesterday requested to see a lady, who five years ago broke the small bone of her leg, as she was attempting to extricate herself from her carriage, after the horses had taken fright. The fracture was situated about two inches and a half above the lower end, and divided the bone in a direction downward and backward. The foot became extended upon the leg, and remained so while the bone was uniting, and in consequence the fractured end of the lower portion is consolidated with that of the upper, at an angle projecting forward at the seat of fracture. This lady continues to experience considerable weakness in the joint, and cannot yet bend the foot sufficiently to enable her to bring the heel to the floor as she stands upright. The weakness and claudication, under which she still labours, induced her to request my professional attendance. When both bones are divided, the displacement which attends the employment of these splints is commonly more considerable and more irregular, varying, however, in different cases, according to the degree of laceration which accompanies the fracture of each bone, and other circumstances.

Case.

Some time ago I was in attendance on a lady who had had a fracture of both bones of the leg, produced by a blow as she was on horseback. The fracture of the fibula was about two inches and half above the malleolus and that of the tibia separated the base of the bone from the shaft in a direction slightly downward and inward. In this case the split-deal splints had been employed and had forced the fractured ends of the fibula inward, where they united in contact with the tibia. The fractured end of the shaft of the tibia was thrown slightly inward, so that the displacement of the fractured ends of the fibula was rather more extensive than it would have been, had the tibia not been injured. The appearance which the foot and leg presented was very similar to that which is observed when the tibia is semi-luxated inward. The ancle-joint remained very weak for a long time after the union was completed, in consequence of the deformity which had been produced. The lady, however, ultimately recovered so as to be able to walk with freedom and without limping. No attempt was made to replace the bones into their natural situation after I saw her, as I did not think myself justified in having recourse to any measures calculated to destroy the bony union which had taken place.

Mr. Sharp's splints.

Mr. Sharp's splints are very commonly used in this country in the management of fractures of the leg. They are, however, open to many objections, which I shall now endeavour to point out.

Application.

In applying these splints, it is usual to place the longer, which has a piece attached to the lower end for the side of the foot to rest in, on the outer side of the leg, and the other on the inner side, and to pass tapes round the limb over the splints to confine them. Some surgeons have the foot-part of the inner splint made the same as that of the outer (*Fig. b*).

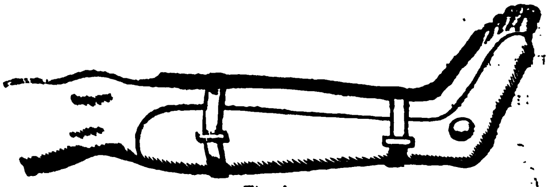


Fig. b.

This is found to be an advantage, as it assists in giving lateral support to the foot.

Position.

Some surgeons who employ these splints, place the limb in the straight position, with the foot resting upon the heel; and others bend the knee a little, and let it lie upon the outer side supported by a pillow.

Objections—upon the heel.

When the limb is laid in the straight position, with the foot resting upon the heel, these splints give little, if any, support to the back of the leg, and we find, what might indeed be expected *à priori*, that when the fracture is loose, there is great difficulty experienced in keeping the fractured portions in a proper line. The pillow upon which the limb is placed, gives way more in one part than it does in another, according to the degree of weight that may happen to press upon it in any particular situation. This occurs frequently at the foot, the weight of which causes the pillow to yield in a greater degree here than at any other part, and in proportion as it does so an angle is formed, projecting forward at the seat of fracture, *(Fig. c.)*

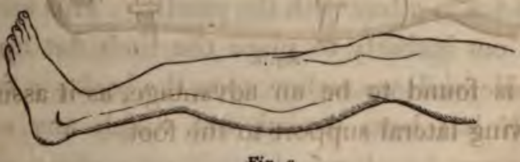


Fig. c.

The surgeon endeavours to support the heel with pillows and pads of various sizes; but it seldom happens that he is able to do this, in loose fractures, so effectually as he could wish. If, however, after much trouble, the heel be kept pretty steady, and prevented from sinking below its proper level, he has still another evil to contend with, viz. the sinking of the middle of the leg, which gives rise to the formation of an angle projecting backward at the seat of fracture. *(Fig. d.)* In his attempts, which are often repeated, to remedy these deformed states of the limb, he gives the patient pain, and produces motion in the fracture.

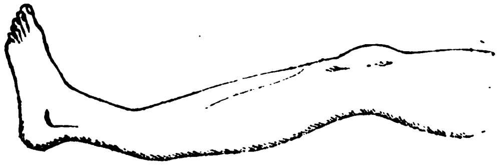


Fig. d.

pon the side.

When the limb is placed upon the outer side, there is danger of eversion of the foot, unless great care be taken to support the ball of the great-toe in a line with the patella. This arises from our inability to place the limb flat upon the side while we recline upon the back; a fact which has been denied, but which any one may prove by placing himself on a plane, and attempting to lay the limb on the outer side.

Were the patient to place and keep himself upon the side through the whole line of his body, the danger of eversion of the foot would be greatly diminished; but he soon finds lying upon the side a very painful position, and, in order to relieve himself, he turns round upon his back. This he cannot do with impunity, as long as the limb remains upon the side, for the pelvis, moving round, carries that part of the limb above the fracture with it, while the part which is situated below the fracture, not being influenced in any considerable degree by the part above, remains upon the side. By this rotatory movement of the trunk and, with it, the upper part of the limb, the fractured portion of the bones are thrown out of their natural line, and if they are suffered to unite, as they are thus displaced, eversion of the foot will be the consequence.

I shall mention two other evils which attend the use of these splints, whether the limb be placed in the straight position upon the heel, or in the bent position upon the side; one of which is motion of the fractured ends, often produced when the limb is moved by the patient or the surgeon, either by accident or design; and the other is shortening of the Motion. Retraction.

limb, which almost always takes place in oblique fractures of both bones when these splints are used, and sometimes to the extent of several inches. In short, there is not a single indication properly answered by the operation of these splints.

I do not mean to say that there are no fractures of the leg in which this mode of treatment might not be followed with impunity, as far as the union of the bones, and the proper apposition of the fractured ends are concerned. My readers must be aware that this could not be my intention; for I have said there are some fractures which, if the patient be kept quietly in bed, will do well without any splints at all, and there are others for which the little support afforded by these would be sufficient, provided the patient maintain the horizontal position. It should be remembered, however, that when these splints are used, the patient must be confined to his bed, a circumstance which is rarely necessary for more than a few days in the management of simple fractures of the leg. I should say, therefore, were it only on this account, were there no danger of deformity or non-union, that they ought not to be recommended in any case of complete fracture of one or both bones of the leg, where better means can be obtained.

When the split-deal splints are used long enough to extend from the condyles of the femur to the sole of the foot, one being placed on each side of the limb, they operate much in the same manner as long junks—a variety of splints, which as they are commonly used, consist of long flat pieces of wood, varying in width according to the size of the limb. These splints are commonly used long enough to extend from the sole of the foot to a little above the knee, and when this is the case, the knee and ancle-joints lie between them. Long junks.

When the long junks are applied, the limb, as far as I have observed, is always placed in the straight position, with the foot resting upon the heel. Position.

These splints are preferable to those which extend only from the knee to the ancle; for, however much they allow of displacement, they do not, like the short splints, tend to produce it. But do these splints answer the indications which have been pointed out? According to the view which I take of their operation, Objections.

I should say, that they do not answer any one of them steadily and effectually. Why? Let us pursue this matter a little further. Do these splints, even when they extend from above the knee to the sole of the foot, fix the knee and ancle joints? No. To prevent a hinge-joint from moving, we should oppose a force in the direction of its motion, which when applied to the knee, should consequently be made to operate either in front or behind the joint; so also when employed to confine the ancle-joint, though in a modified manner. But the splints now under consideration, operate upon the sides of the joints, where their influence is not likely to be sufficient to prevent the bones of which these joints are composed, from moving upon each other. Do they afford proper support to the heel or to the sole of the foot? I do not hesitate to answer in the negative. Consequently we observe, that the foot is sometimes forced by the action of the muscles and other causes, too much backward, producing an angular displacement of the broken bones, the fractured ends of which project anteriorly; sometimes it is forced too much forward, giving rise to angular displacement, with the fractured ends projecting backward. In the first variety of displacement, the convexity of the curve is formed by the front of the leg; and in the second, the front of the leg is more or less concave. Is there any thing in these modes of treatment, calculated to prevent the fractured ends from overlapping when the fracture is oblique? Certainly not. Neither extension nor counter-extension can be effected with them. The gravitation of the body towards the foot of the bed, and the action of the muscles, are allowed to produce their injurious effects in the direction of the long axis of the leg, much the same as if no mechanical support were adopted. Hence we find that, when these means are used, oblique fractures unite with a degree of shortening more or less extensive, according to the degree of obliquity which the fractures take through the bones, and the degree of laceration of the soft parts by which they are accompanied. Can these splints be so employed as to prevent the fractured ends from moving upon each other when the limb or the trunk is moved? If so, I am ignorant of the mode. If the patient be confined to bed in one position, but little motion will take place; and this mainly under the convulsive twitches of the muscles, and the slight movements of the trunk, made by the patient to answer the calls of Nature. The indication which these splints fulfil more effectually than any other is, that which relates to the lateral support of the foot, so as to prevent eversion or inversion; but even this indication is very imperfectly answered by them without the assistance of other means. Every practical surgeon must be aware of this, who is accustomed to employ them, and note with attention the results of his cases.

Some surgeons might suppose, that my condemnation of this mode of treatment is made in terms too general and decided; for, however clearly it can be demonstrated, upon mechanical principles, that these splints do not answer the indications pointed out, and however clearly it can be shown, by the results of cases, that their influence cannot generally be depended upon, there can be no question that many fractures unite very well, when no other means are used: granted. I do not mean to argue that these splints cannot be used with impunity in any case of fracture. Most cases of fracture of one bone without laceration, and some where both are divided, will unite under their influence in a reasonable time, and without the occurrence of deformity, provided the surgeon be careful. But there are so many instances of deformity and weakness, and non-union taking place under the use of these means, and the others of which I have spoken, even when employed by the best practitioners, that in my opinion the conscientious and scientific surgeon will scarcely feel himself justified in recommending the adoption of either, even in the most simple varieties of complete fracture which we are called upon to treat; for, in these cases, they require the patient to be confined to bed unnecessarily, and at the same time allow of malposition of the foot and other parts, and motion of the fractured ends of the bone upon one another, from all and each of which much mischief frequently ensues.

Assilini's trough.

Assilini's trough is a contrivance occasionally employed in the treatment of simple fractures of the leg.

Application.

When this apparatus is used, it is laid upon the bed, and the leg is placed in it, with the toe pointing upward. The calf of the leg drops into the excavated part in the middle, and the heel into the space just above the foot-board, where it sinks down upon a pad of some kind, placed under the apparatus to receive it. The foot is brought up against the foot-board, and confined there with a bandage.

Objections.

It has always occurred to me, that whatever apparatus is used in the treatment of fractures of the limbs, it should be made in such a manner as to admit of being adapted to limbs of various sizes, and to the same limb in different states of tumefaction. If the apparatus does not allow of this, the limb cannot be steadily supported throughout the period necessary for the production of union. Now, the apparatus under consideration does not admit of being enlarged and contracted to suit limbs of different sizes, consequently is only applicable upon this view when the limb exactly fits it, which the same limb would not do during the whole period of confinement. This is an apparatus which cannot be adapted to the limb, but, like many other contrivances, requires the limb to be shaped and adapted to it, which its construction does not admit of being easily and steadily accomplished.

I have noticed several other objections to the use of this apparatus, one of which arises from the necessity of placing the limb in the straight position, which I have stated frequently gives rise to some stiffness in the knee-joint, which is much less when the knee is kept bent. I do not mean to say that the straight position is never necessary in the treatment of any variety of simple fracture of the leg, but I may observe, that it has not been required in any case that I have witnessed, except where there has been an unusual degree of injury sustained by the contiguous textures. Another objection arises from its not giving support to the heel. Whatever support the heel receives, is given to it by a pillow or pad, placed beneath the apparatus. This support cannot be steady and permanent, consequently the fractured ends of the bone will be displaced whenever the heel sinks below its proper level. A third is, want of support to the upper part of the limb. When the patient moves he is in danger of producing motion in the fracture, and of displacing the fractured ends. It is open also to an objection which it has in common with all those apparatuses which have a frame, for it fixes that part of the limb which is below the fracture, so that it cannot move towards the foot of the bed with that portion which is above the fracture, and which is constantly forced towards the foot of the bed by the gravitation of the body. This, in conjunction with the action of the muscles, tends to produce shortening of the limb, which sometimes takes place to the extent of several inches. In short, the only indication answered effectually by this contrivance is, that of preventing eversion or inversion of the foot, which it does by the operation of the foot-board, when the foot is properly confined.

wing-box.

I shall mention one other contrivance which I have often seen employed, and which I am told is sometimes used in the army, though it does not appear to be generally known—I mean the swing-box. This consists of a piece of board for the leg to rest upon, with a sliding foot-piece attached to one end, some pieces of split-deal splint fastened to the sides of the board, and four small iron eyes, one of which is screwed into each side of the upper and lower ends of the board. This assemblage of parts might be called the box of the apparatus. The frame, by means of which the box is suspended, consists of a piece of wood about twenty-four inches by twelve, with folding sides and four uprights projecting from it, in a direction perpendicular to the plane. These uprights are also made of wood, and are about sixteen inches high, by one and a half thick, having little wheels fixed in them at the upper end. One of the uprights is inserted into each corner of the board, like the leg of a stool. To complete the apparatus, a small cord is introduced into each of the iron eyes, screwed into the side of the box and fastened to it. These four cords are passed over the pullies, at the tops of the pillars of the frame, and fastened so as to suspend the box.

Mode of using the swing-box.

When this apparatus is used, the frame, which has somewhat the appearance of a four-legged stool turned upside-down, is placed upon the bed. The box is placed between the uprights, and the cords are tied so as to suspend it at any degree of elevation that the surgeon may think advisable. The box, when thus arranged and properly padded, is ready for the reception of the injured leg, which is placed in it, with the knee in the bent position, resting upon the calf and the heel, as the patient lies upon his back. The floor of the box is regulated to the length of the leg by shifting the foot-piece, which moves in a groove at the lower end of the board upon which the leg rests, and at any part of which it might be fixed by means of the connecting screw. The foot-piece supports the sole and sides of the foot, which is fastened to it by means of a bit of bandage, and the upper end of the leg-piece rests against the back of the ham. The sides of the box are brought up with a view to give lateral support to the leg, and confined by means of straps or tapes.

Advantages.

The advantages which I have noticed to arise from the use of this contrivance are as follow: It supports the sole of the foot, and prevents eversion or inversion. It might be applied so as to keep up a little extension, and it renders the fractured parts less liable to motion, than they are when placed in either of the other contrivances which I have mentioned.

Objections.

There are, however, several objections to this contrivance, which it is proper the surgeon should be acquainted with. The lateral supports are not calculated to prevent transverse displacement, in cases where there is any disposition to its occurrence. The extending influence is not sufficient to prevent the fractured ends from over-lapping when the fracture is oblique. The position of the foot cannot be regulated with that nicety which many cases require. The fractured ends get displaced, and, whenever the surgeon attempts to reduce them, he produces injurious motion in the situation of the fracture. The leg altogether is so loosely supported, that the various movements of the body also occasion more or less motion of the opposing surfaces upon each other, and in this way tend to retard the union. So imperfect is the operation of this box, that, though I have seen many cases treated with it, I do not recollect one, in which more or less deformity did not take place. I have seen Mr. Sharp's splints used with it, in order to assist in keeping the fractured ends together, but even with these it does not answer. I remember a melancholy instance, shewing the inadequacy of Mr. Sharp's splints and the swing-box, separately and conjointly. A person in the prime of life, had a simple fracture of the leg, and the surgeon endeavoured to keep the bones in their proper position by the application of Mr. Sharp's splints. The fracture, however, became compound under the use of these splints. The limb was then placed in the swing-box. High irritation and most extensive suppuration supervened. Mr. Sharp's splints were used in conjunction with the swing-box, with a view to afford more effectual support. This plan also failed, and the patient, refusing to lose the limb, died, after a protracted course of very severe suffering, with the limb in a most shocking condition, which, in my opinion, was altogether attributable to the inadequacy of the plans of treatment to which the surgeon had had recourse.

Sec. 3.—*The Author's Mode of Treating Simple Fractures of the Leg.*

Observations.

Having given a short sketch of the imperfections of the means usually resorted to in the management of simple fractures of the leg, it now behoves me to make my readers acquainted with some contrivance better calculated to answer the indications which we have observed than any of those already mentioned.

In doing this, I must again direct your attention to the consideration of the apparatus, which I partly described when speaking of fractures of the thigh (*see* page 335). The assemblage of the parts of this apparatus, which I formerly used in the management of simple fractures of the leg, formed the model upon which that apparatus which I now employ was made. This assemblage of parts, consisting of the thigh-pieces without the sliding-plate, the leg-piece, foot-piece, and shoe, properly ted, and the lateral shin and leg-splints, be used with impunity, by those little into this feeling, we shall find that it is nothing more than what might naturally be expected. Patients know nothing scientifically of the nature of fractures, or of the means made use of for their cure, consequently they judge of the surgeon's ability according to the results of his cases. If the case of an individual terminate well, he conceives that the surgeon has done his duty; but if the limb be deformed, the patient will immediately say that the fracture was badly set, and he gets confirmed in this opinion by the observations of his friends, who seldom fail to find out cases to substantiate their belief.

Setting.

To put the fragments of a fractured bone into their proper situation, which is called setting the fracture, is one thing; and keeping them there, during the uniting process, is another. The first is usually easily accomplished; but the second often requires much attention and care, and, frequently, with the common contrivances, cannot be done.

I have little to say on the subject of setting a simple fracture of the leg. The fractured parts should be brought into that line which is natural to the bones. This, and the mode of

bjects in the
nstruction of
e apparatus.

In contriving an apparatus applicable for simple fractures of the leg, I endeavoured to possess myself of means by which I could avoid all those evils which so frequently accompany the use of the common splints and machines, and to put every variety of simple fracture of the leg under the complete command of the surgeon. If I have succeeded in doing this, I have accomplished a great desideratum;—I have put the members of the profession in the possession of an apparatus, by the proper employment of which, they may prevent that opprobrium so frequently cast upon them by persons unacquainted with the nature and the state of the science of surgery, in consequence of the deformity which is often the result of fractures of the leg.

eelings of pa-
ents.

It is not easy for gentlemen, who have not observed the feelings of patients and their friends against a surgeon, under whose care a fracture badly united was placed, to form an estimate of their usual inveteracy. They sometimes think they can never injure his reputation sufficiently; and though the surgeon, in many instances, is not at all deserving of blame, they usually load him with epithets of ignorance, neglect, and presumption. If we examine a

accomplishing it, the anatomy of the parts will immediately suggest.

Apparatus described.

To keep the fractured bones in their natural line, I make use of the apparatus, to which I have already alluded, and which I will now briefly describe. The apparatus, (*Fig.* 1.) consists of the following parts: a thigh-piece, *a*, properly shaped to receive the back of the thigh, and having connected to it a pair of lateral splints, *b*, and some studs for the retention of straps; a leg-piece, *c*, immoveably connected to the thigh-piece at an angle, and hollowed out for the reception of the back of the leg; a foot-piece, *d*, which admits of being shifted, so as to adapt the leg-piece to the length of the leg. This ought not to rise higher than is sufficient to form a right angle with the leg-piece when connected with it. It has some holes on each side, and a strap attached to it, having a buckle at one end. A shoe, *e*, with a wooden sole for the reception and retention of the foot. This shoe has two straps attached to it,

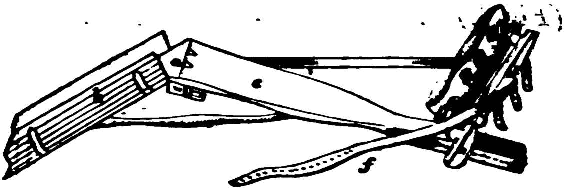


Fig. 1.

which admit of its being connected with the foot-board, so as to support the foot at any desirable degree of elevation, and prevent the fractured ends from overlapping. These parts together form the apparatus; to which are adapted, so as to suit the natural configuration of the limb, lateral splints *(Fig.* 2*)*, a shin-splint *(Fig.* 3*)*, and a thigh-splint *(Fig.* 4*)*, which, when the apparatus is employed, are confined upon the limb, with straps and buckles, which are *much* preferable to tapes. The foot-board is supported by a foot-strap *(Fig.* 1, *f)*, which, when in use, extends from one side of the thigh-piece round the bottom of the foot-board, where it is passed under a strip of leather placed there to keep it in its place, and then carried up to the opposite side of the thigh-piece, where it is buckled.

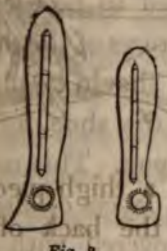


Fig. 2.

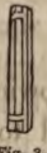


Fig. 3.

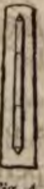


Fig. 4.

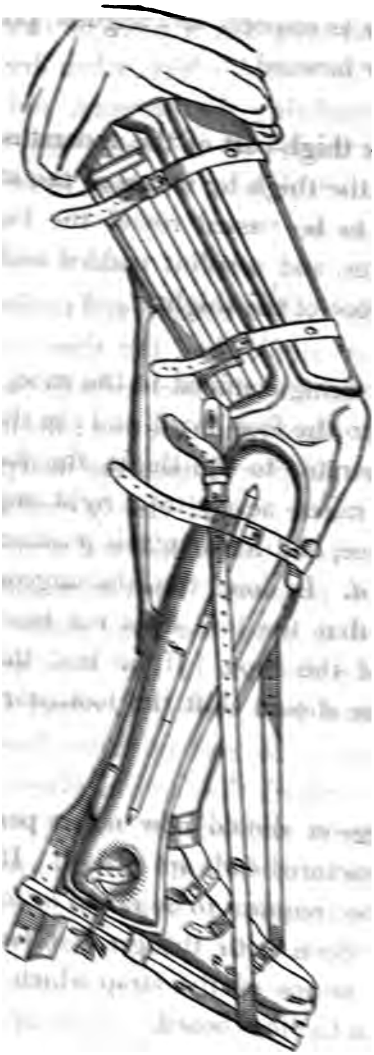
Padding, &c.

The apparatus to be used should be adapted to the sound limb in all cases of simple fracture of the leg, and padded so as to protect the soft parts from injurious pressure. The surgeon should take care that the pads are properly constructed, which he will always do, if he pays proper regard to the feelings of his patient. The general pad used to cover the thigh and leg-parts of the apparatus, should be composed of the same materials, and be about the same thickness, as that recommended to be used in the management of simple fractures of the thigh, (*see* page 342). A small pad should be placed on the inside of the heel of the shoe, for the projection of the heel to rest upon. This might be composed of three or four layers of flannel (according to the thickness) covered with soft linen or calico. Two or three of the layers should have a hole cut in them, in order that the pressure upon the back of the heel may be so distributed, as not to produce inconvenience. If this be neglected or improperly managed, inflammation, and even sloughing of the integuments over the projecting part of the os calcis might be produced; but if the heel of the shoe be padded with care, the patient will not complain. I may here mention, also, that, in oblique fractures, it is necessary to protect the instep from the influence of undue pressure, which is easily done, by placing a thin pad upon it, and over this a piece of thick pasteboard, a little wetted, which, when dry, has the effect of equalizing the pressure, and keeping the instep easy. A thin pad may also be placed at the bottom of the shoe, in some cases, with advantage.

Application for transver fractures of leg—first sta

When the pads are made, and the instrument is ready for application, the shoe, *a*, *Fig.* 5, p. 422, containing the heel and sole-pads should be carefully placed upon the foot; the instep-pad should then be placed upon the instep, and the shoe closed over it, and closely confined to the foot, by means of the buckles and straps attached to it for this purpose. Then an assistant should be directed to place one hand under the knee, and to take the foot in the other, and raising the fractured limb, bring it round so that he might place it to rest upon the heel. When the limb is raised, the surgeon places the apparatus under it, and brings the angle of the apparatus opposite the bend of the knee, and then directs the assistant to lower the limb upon it. The surgeon now fixes the shoe, *a*, to the footboard, *b*, by means of the straps attached to the wooden sole. By the assistance of this shoe, he is able to raise or lower the foot according to the length of the heel or thickness of the

Fig. 5.



calf, so as to bring the lower portion of the fractured bones into a proper line with the [illegible] upper, as far as respects any angular projection backward or forward.

Now, the thigh-part of the apparatus should be fixed to the thigh by means of the straps, *c*, which are to be passed round the limb over the apparatus, and a splint padded and placed upon the front of the thigh.

The foot being confined in the shoe, and the shoe fixed to the foot-board, and the thigh-part of the apparatus to the thigh, the foot-board should be raised nearly to a right angle with the leg-piece, and fixed in this position by the foot-strap, *d*. In doing this, the surgeon should take care that the heel does not bear against the sole of the shoe. If he find this to be the case, he should shift the foot-board a little lower.

Review of the application.

The surgeon should now notice particularly how the fractured ends are placed. If he finds that the foot requires to be raised or lowered, it might be done with the greatest facility and nicety, by means of the strap which suspends the shoe to the foot-board.

The part of the pad, *e*, which lies under the small of the leg, should be raised and supported in close contact with it, by means of tow or other soft material placed between the pad and this part of the apparatus, so that the whole length of the back of the leg may have an equal bearing upon the apparatus.

The lateral splints, *f*, are next to be applied. The longer of these should be placed along the outer side of the leg, and should be long enough to reach from the foot-board to the upper part of the outer condyle of the femur; the shorter should be placed along the inner side of the leg, and should extend from the foot-board to the inner condyle of the femur. The lower end of these two splints should be fastened to the foot-board with narrow tape or riband passed through the holes at the sides, and the upper ends kept close to the leg by the circular strap, *g*, passed round the limb over the splints and the apparatus.

sition.

The limb thus fixed, should be placed with the apparatus resting upon the heel, and should be steadied in this position by tapes attached to the foot-board, and running off from it to the sides of the foot of the bed*. In this state sedative lotions might be applied to the leg; and, if the condition of the injured parts should render the application of leeches advisable, the surgeon has only to unbuckle the circular strap, g, and throw back the side-splints, in order to have the whole of the front and the sides of the leg exposed for this purpose; which might be easily done without any danger of disturbing the fractured ends of the bone. When the inflammation arising from the accident is sufficiently got under, which is usually accomplished in the course of three or four days, varying, however, in different cases, according to the severity of the injury sustained by the soft parts, the treatment requires to be a little modified.

---

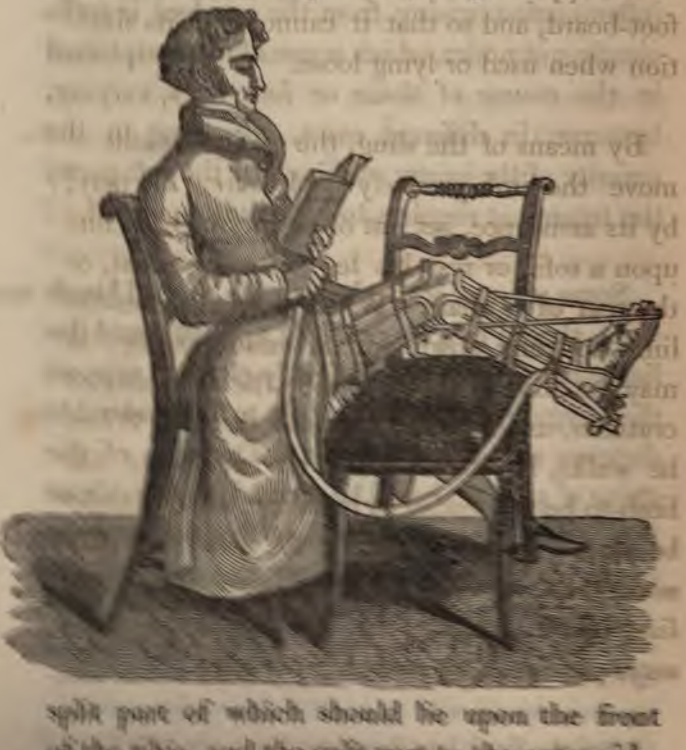
* Some surgeons think that a bit of wood, about a foot long, attached transversely to the lower end of the apparatus, would be a better mode of steadying the apparatus upon the

Some strips of soap-plaster, each about 1½ inch wide, should now be carefully applied round the limb, not tight, but sufficiently close, to support the integuments from the ancle to a considerable distance above the fracture. The ends of the strips of plaster should be crossed on the side or front of the leg, and cut off, so that they may be easily turned back, if necessary, to examine the Second stage

bed. This plan, however, is objectionable, and might be injurious. The tapes answer every purpose, without counteracting any principle upon which the apparatus is constructed.

state of the skin, &c., without disturbing the fracture. I apply, also, at this period, some strips of plaster, or a short roller, round the foot, for the purpose of supporting the integuments, which otherwise become the seat of œdematous swelling, to a degree that sometimes annoys the patient. The soap-plaster and bandage being applied, re-adjust the side-splints padded; and now also the shin-splint, *a*, *(Fig. 6)*, the unsplit part of which should lie upon the front of the tibia, and the split part to the outer side.

Fig. 6.



Three straps should be carried round the limb over the apparatus and the splints, and buckled sufficiently close to give adequate support to the whole.

The limb being thus secured, the patient should be furnished with a sling, *b*, which should be fixed to the lower end of the leg-part of the apparatus, so that it cannot act upon the foot-board, and so that it cannot shift its situation when used or lying loose. Sling.

By means of the sling, the patient is able to move the limb passively at pleasure. He may, by its assistance, get out of or into bed, recline upon a sofa, or rest his leg upon a leg-rest, or the seat of a chair. When he can suffer the limb to hang down without much aching, he may be allowed to walk, with the assistance of crutches, as his inclination may direct. When he walks, he should suffer the weight of the limb to be suspended by the sling, which should be placed across the neck in the usual way. *He must take care, also, that he never moves the limb by the action of its own muscles, but always passively, by means of the sling.* Use.

After the limb has been confined about a fort- The foot-board to be shifted.

night, or from that to three weeks, according to circumstances, the foot-board should be shifted up along the leg-piece a little, so as to press the fractured surfaces together. This causes consolidation of the fractured ends to take place more speedily than it otherwise would; which is to be attributed partly to the increased action which the pressure occasions.

The parts to be occasionally examined.

The surgeon should remove the three short splints occasionally, in order to ascertain that the patient has not displaced the bones, by acting contrary to his directions. We cannot always depend upon the assertions of our patients, who may, sometimes, be deceived; it is, therefore, advisable, that we should examine the limb from time to time, for our own satisfaction.

The following cases will tend to show the advantages derived from the use of this apparatus, when employed in the management of fractures of the leg, which divide the bones transversely, or in a direction only slightly oblique.

Case.

A man, aged 42, a patient of Mr. Travers', in St. Thomas's Hospital, had a fracture of both bones of the leg, produced by the force of a heavy body, which fell upon the limb. The fracture of the fibula was about two inches above the point of the malleolus, and that of the tibia, extended a little obliquely downward and backward, through the inner malleolus, commencing about an inch above it.

I saw this man with Mr. Travers on the day of his admission into the hospital, which was on the fourth day after the accident. The limb was lying between two common leg-splints. The foot was extended by the action of the gastrocnemii, and the fractured surfaces were separated in front, considerably from each other. Mr. Travers, to whom I am indebted for many cases, politely offered me the management of this. The apparatus was now applied as for transverse fractures of the leg, there being no probability that the fractured ends would overlap after the apparatus was properly adjusted. The inflammation produced by the force which occasioned the fracture, was at this time sufficiently got under, to admit of the immediate application of the whole of the splints, in the manner above-described. When the limb was secured, the man was desired to have his bed made, and to get out of bed for this purpose daily. On the seventh day after the accident, the man left his bed, and walked about the ward, with the assistance of crutches, as often as he felt inclined. This he continued to do daily, till the twenty-fourth day, when the apparatus was removed. At this period, the bones were found united firmly, without the least appearance of displacement. The man soon recovered the use of his limb.

Case.

A man, æt. 55, fell from the step of a carriage, with his foot twisted under him, and broke the tibia obliquely into the ancle-joint, and the fibula a little above it. Considerable swelling followed the injury, which, however, speedily yielded to the influence of leeching, and other means calculated to subdue the inflammation.

On the second day the apparatus was applied, without the shin-splint. He had at this time some symptomatic fever, which was removed by a purgative.

On the fourth day, the inflammation having sufficiently subsided, the shin-splint was applied, and the man was furnished with a sling, and ordered to get up and place his limb across a chair. On the fifth day, he began to walk with the assistance of crutches. At this period he felt pain when the limb was hung down, but this soon subsided when the limb was placed across a chair; and, in the course of a few days, it became immaterial to him whether the apparatus rested upon the chair, or upon the floor. On the twenty-fourth clear day after the accident, it was found that the fractured ends were accurately joined together, by the interposition of callus. A roller was now applied round the foot and leg, and the man was desired to exercise the muscles of the limb a little, as he walked with the assistance of his crutches.

At the expiration of five weeks after the accident, this person was able to walk without crutch or stick; but, as he had not yet acquired full power over the muscles of the leg, he was desired to steady himself with one or the other, till the functions of the limb were more completely restored.

A man, aged 23, slipped off the curb-stone, Case. and, his foot twisting under him, he fell in such a manner as to produce a simple fracture of both bones of the leg. The fracture of the tibia was rather oblique, extending through the bone downward and inward, and was situated about two inches above the malleolus. The fracture of the fibula was rather more distant from the ancle.

The apparatus was applied on the second day, and on the third day the inflammation was so much got under, that I thought he might leave his bed with safety. The limb was accordingly done up in the manner I recommend for fractures in, what I call, the second stage, and the patient was desired to get out of bed; which he did without assistance, lifting the limb by means of the sling. After this he used his crutches daily, walking about as he felt disposed till the twenty-third day. The bone was now united, and the use of the apparatus discontinued. The fractured ends overlapped a little before the apparatus was applied, but so accurately were they joined under its influence, that it was not without a careful examination, that persons who were not acquainted with the situation of the fracture, could discover where it was. He soon recovered the natural powers of the limb.

John Basset, æt. 49, a patient of Mr. Green's in St. Thomas's Hospital, had a fracture of the tibia a little above the malleolus, extending transversely through the bone, accompanied with a fracture of the fibula, situated about two inches from the lower end. The fracture was very loose, and was occasioned by his jumping out of a gig, and twisting the foot under him when he pitched upon the ground.

The simple fracture apparatus was applied. In this case the injury sustained by the soft parts was so considerable, that the consequent inflammation was not sufficiently subdued to allow of his getting up with propriety till the eleventh day after the accident. The limb was now supported as for the second stage, and the man was ordered to leave his bed, and use his crutches at pleasure. This plan was continued till the 22d day, when the apparatus was taken off, and the bones were found firmly united without displacement of any kind. On the 26th day he left the hospital, rapidly recovering the use of his limb.

A female, aged 45, slipped off the flag-stones, Case.
with the foot twisted under her, and falling, broke both the bones of the leg a little above the ancle-joint. I saw this person on the 14th day after the accident, and was informed that, though many attempts had been made, it was

found impossible to keep the fractured parts in their proper position by any of the usual means; and that she had suffered greatly from the convulsive action of the extensor muscles of the foot, which had kept the foot constantly in the extended position. The pain and tension had been great, and the symptomatic fever so high as to produce delirium; in which state she got out of bed, but fortunately did not force the fractured ends of the bone through the skin. The usual means resorted to for the purpose of getting rid of the inflammation and fever had been employed, but there was still considerable tension and much pain experienced in the injured parts. The limb was now lying in the straight position. The foot was extended, and also drawn backward and upward by the action of the muscles, so as to produce an angle, projecting forward at the seat of fracture. The fractured end of the lower portion was forced so strongly against the skin that there was great danger of its coming through.

The apparatus was now applied, and I was happy to find that, in the course of two days, I had succeeded in reducing the inflammation and tension sufficiently to enable me to secure the fractured parts as for the second stage, and allow the patient to get up and place the limb across a chair. She soon began to walk with the assistance of crutches, which she used whenever she felt inclined. She wore the apparatus altogether three weeks, during which, consolidation of the bones was effected without any perceptible displacement of the fractured ends. This person gradually recovered the use of her limb, and was able to walk without assistance at the end of about six weeks; but, in consequence of the high inflammation which succeeded the accident, she was not able to throw aside her crutches altogether till the end of the seventh week.

A female, aged 42, fractured both bones of the leg in the following manner. As she was walking along the street, the point of the foot slipped into a hole, and she fell on the opposite side of the body, while the foot remained entangled in the hole. The gentleman who first saw this patient, informed me that there must have been great laceration of the soft parts; for the lower portion of the tibia was thrown forward, the sole of the foot turned inward, with the inner edge raised, and the toes much pointed downward. Case.

I saw this person on the third day after the accident, and applied the apparatus as for the first stage of fracture, there being, at this time, a good deal of inflammation and swelling. The woman had her bed made immediately after the application of the apparatus, the support of which greatly mitigated her sufferings. On the sixth day the limb was done up as for the second stage, and the woman desired to sit up with her leg placed across a chair or rest. At this time, the limb had become easy, and she did not find any pain produced by sitting up with the limb raised; but when she placed it upon the floor, she again felt pain. This, however, soon subsided, and she began to use her crutches in three or four days. She wore the apparatus twenty-seven days, at the end of which the bones were found firmly united. This person rapidly recovered the free use of the limb, which was free from deformity of any kind.

Remarks.

The above are sufficient to illustrate the effects of the apparatus in the management of those cases of fracture which are situated in that part of the leg where similar fractures are found the most difficult to treat by any of the means commonly employed. I have selected them from among the very worst examples of the kind that have fallen under my observation and management. I might add a large number of cases situated in different parts of the bones, but as these are treated with equal facility with those already mentioned, it would only be tiring the patience of my readers, and increasing unnecessarily the bulk of the work, to relate any more of them in detail, and more especially as my practice has been already extensively adopted, in this and other countries, with very favourable results.

Surgeons, however, must not expect to give the patients all the advantages I have mentioned; nor will their cases be equally successful, unless they make themselves acquainted with the principles upon which the apparatus is constructed, and pay due attention to its application and management; the neglect of which even in what may appear to some, minute particulars, may allow of considerable mischief or delay. The following case will tend to illustrate these observations.

I was requested to see a gentleman, residing about ten miles from town, who had a trans- Case.

verse fracture of both bones of the leg, in the middle-third, produced by a fall from his horse three or four days before I was called to him. I found the limb considerably swollen, and very painful, and I consequently applied the apparatus in the manner which I have recommended for fractures in the recent stage. I saw him again in two or three days, and found the swelling had much subsided, but not sufficiently so to allow of the application of the apparatus as for the second stage. I now directed the surgeon in attendance how to proceed, and took my leave. Five weeks afterwards I was informed that the limb had been examined, but the bones were not consolidated. At the end of eight weeks I was requested to see this gentleman again, as union had not taken place, and fears were entertained, that the liberty which had been given him to walk with crutches, to go out in his carriage, &c. should have retarded the cure. On my arrival I found every thing properly adjusted according to my instructions, except the sling, which, instead of being fixed to the leg-piece of the apparatus, was fastened to the foot-board, in such a manner as must have produced frequent motion in the seat of fracture. I satisfied myself as to the condition of the limb, and adjusted the sling as I have directed, and told the gentleman to continue his airings as before. The bones now united in a short time under the same line of treatment properly conducted, and the result showed very evidently that the cause of the delay which had taken place was the misapplication of the sling.

Here I would also caution the patient against interfering in any manner in the management of his case; for, by so doing, he may occasion deformity, or much retard the cure; as occurred in the following case.

Case.

A woman, who was 61 years of age, had a fracture of both bones of the leg, extending through the upper-third. The apparatus, in this case, was not, from some cause or other, which I did not note, applied till the ninth day, when the limb was confined as for fractures in the second stage, and the woman desired to leave her bed and move about the ward with the assistance of crutches. This woman, from a fickleness of temper, which often occurs in persons of her age, was constantly meddling with the apparatus, and, by so doing, retarded the process of union. At the end of a month, however, she was frightened into a compliance with the directions that had been given her, and which I believe she pretty strictly attended to for the next three weeks, during which consolidation of the bones took place, with the fractured ends in proper apposition.

)blique fracures—applicaion of the pparatus.

When both bones of the leg are broken, and the fracture of the tibia happens to be very oblique, it is necessary to modify the treatment a little. In such cases, we must keep up extension with the apparatus, till the fibula is united, in order to prevent the fractured ends from overlapping. For this purpose, the thigh-piece of the apparatus must be pressed up closely against the back of the thigh, and the foot-board shifted down, so as to make the space between the foot-board and the thigh-piece longer than the leg. When the limb is placed upon the apparatus, and the thigh-piece fixed to the thigh, the assistant should be requested to grasp the foot and ancle in his hands, and make gentle extension in the natural line of the bone, so as to bring the fractured parts into proper adaptation. This being done, the surgeon should take care to keep up the extension, by buckling the strap, which is fixed transversely to the sole of the shoe, round the foot-board. The foot-board, being so constructed that it cannot rise higher than is sufficient to form a right angle with the leg-piece, affords a permanent point of resistance to the action of the muscles, which tends to produce retraction. Here it will be seen, that extension is maintained by the foot-board, and counter-extension by the operation of the apparatus against the back of the thigh. By this arrangement, the leg-part of the apparatus is made to act as an external bone, resisting the muscles which tend to produce displacement in the longitudinal direction, and supporting the leg of its natural length. In these cases, I think it advisable to keep the patient in bed till the fibula is united, which usually takes place in a period extending from a fortnight to three weeks. I am not sure, however, that confinement in bed for the first fortnight or three weeks, would be found generally necessary for the successful termination of cases of oblique fracture; but I think it the safest practice, and therefore recommend it.

Separation o the fractured surfaces.

In oblique fractures there is very generally a disposition in the fractured surfaces to separate laterally. To obviate this, and at the same time prevent deformity, requires a good deal of nicety in the management of the case. The fractured surfaces, however, must be brought into contact, or probably union will be produced only by the intervention of ligament. When the broken portions are suffered to overlap, the muscles, by their ordinary contraction, bring some parts of their sides into contact, and ossific union, accompanied with more or less deformity, commonly takes place; but, by keeping up extension, we prevent the broken ends from overlapping, and thus prevent Nature from following her usual course of reparation; we must consequently provide her with an equivalent by art. If there were only one bone in the leg, this would be easily accomplished, without any danger of producing deformity, by forcing the fractured ends in opposite directions, so as to bring their fractured surfaces into close apposition; but, as there are two bones, we must take care that we do not press them together, as well as the fractured surfaces.

Mode of management.

The way I manage these cases is as follows: The knee and ancle ends of the bones being fixed by the apparatus, and the side splints being attached to the foot-board and padded, as for transverse fracture, I operate upon the sides of the tibia, so as to bring the fractured surfaces together, and at the same time maintain the different portions of both bones, so that they may unite, in that relative position which they naturally occupy. If the fracture be downward and inward, and situated high up in the bone, this might be done by placing an additional short pad between the inner splint and the corresponding pad, in such a manner that the whole of the leverage of this splint, may be made to operate upon the *upper* portion of the tibia. I place, also, a cylinder of linen between the *outer* splint and the corresponding pad, in order to press upon the *outer* side of the *lower* portion of the tibia, without acting directly upon the fibula. A common bandage, from two to three inches wide, rolled up in the usual way, forms a very good pad for this purpose. Now, it will be seen that, when the knee and ancle are fixed, and the lateral splints, thus padded, are brought to operate upon the sides of the limb, the fractured surfaces of the tibia will be pressed together by the intervention of the short pads, and the lower fractured end of the fibula will be drawn into its natural relative position, by the intervention of the interosseous ligament, by which the two bones are naturally connected. If the fractured ends of the fibula be driven towards the outer side of the tibia, by any external force applied to the outer side of the fibula, deformity will be the consequence;

Downward inward.

but this is never done except by persons ignorant of, or inattentive to the operation of the means to which they have had recourse. When the fracture is situated low down, it is generally better to make use of a four-tailed bandage, instead of the inner short pad. In this case, two of the ends of the bandage are passed behind the limb, between it and the long pad which lies upon the apparatus, to the outer side of the limb, and the other two are carried over the front of the leg, and made to meet those carried behind it upon the outer splint, where the ends are tied together, so as to keep the upper fractured portion in its proper place. This bandage should be placed so as to operate upon the bone a little above the fracture. When the four-tailed bandage is employed instead of the inner short pad, the fractured surfaces of the tibia are maintained in apposition, principally by the leverage of the outer splint. According to this plan, the inner splint gives general support to the inside of the leg, but does not operate upon the lower portion of the bone, so as to prevent it from being thrown inward, this indication being already answered by the action of the four-tailed bandage.

ownward and
ıtward.

When the fracture divides the bone in a direction downward and outward, the situation of the lateral opposing forces must be reversed; *viz.* the short pad or the four-tailed bandage placed on the inner side of the leg, must, in these cases, be made to operate upon the lower portion of the bone, and must, for this purpose, be situated below the fractured part, and the cylinder of linen must be made to act upon the upper portion, and must therefore be placed above the seat of fracture.

Downwar forward.

If the fracture runs through the bone downward and forward, the lower portion should be supported with tow or wadding, very carefully placed between the long pad which covers the apparatus and the apparatus itself. The surgeon should consider that his object is to give support to the *lower* portion of the tibia, and to the whole line of the fibula, and will manage his padding, according to the circumstances of the case, to answer these purposes. The fractured end of the upper portion is easily commanded by a four-tailed bandage, the unsplit part of which is placed upon the front of the leg just above the fracture. The two tails hanging to the inner side of the leg, should be carried round over the apparatus, to meet the other two at the outer side of the apparatus, where the corresponding tails should be tied together, so as to give the necessary support.

Downward and backward.

When the line of fracture is downward and backward, the four-tailed bandage must be placed below the fracture, and the tails tied, as above directed, in such a manner as to keep the fractured end of the lower portion of bone from rising. In this variety, the upper portion of the bone commonly derives sufficient support from the muscles of the calf of the leg, to enable the surgeon to bring the fractured surfaces properly together, without any particular padding for this purpose. In all these varieties of oblique fracture, and all others that I have noticed, the shin-splint, carefully applied, very much assists in keeping the fractured ends in accurate apposition, and in a state of local quietude.

Time in uniting.

According to my experience, oblique fractures of the leg take a longer period in uniting than those which are transverse. This, I think, is partly to be attributed to the longer confinement in bed, which I have thought it prudent to recommend in the management of the former cases.

Case.

A man, aged 39, had a fracture of the right leg, produced by a kick from his opponent, in the act of wrestling. Both bones were broken about the upper part of the lower third, and the fracture of the tibia divided the bone obliquely downward and inward. I did not see this person till the fifth day after the accident. Upon examining the limb, I found the fracture very loose, and the lower portion drawn up considerably along the outer side of the upper. The apparatus was now applied, but the retraction which had taken place could not at this time be easily overcome. The muscles, however, and the adhesions which had taken place, yielded to the influence of the apparatus in the course of a few days. The man had his bed made occasionally, and, as soon as the fibula was united, he was allowed to use his crutches, supporting the limb with a sling. He wore the apparatus forty-seven days; and, when it was removed, firm union was found to have taken place. The fractured surfaces were not perfectly opposed to each other throughout. A slight projection of the fractured end of the upper portion could be felt, by carefully examining the part with the finger; but the displacement could not be perceived, by loooking at the limb. The natural functions of the limb were restored in a short time after the removal of the apparatus.

Case. A man, aged 30, was admitted into St. Thomas's Hospital, under Mr. Green, with a very loose fracture of the tibia and fibula, through the middle third. The fracture of the tibia extended obliquely downward and backward; and was so loose, that the greatest care was necessary, to prevent the fractured end of the lower portion from lacerating the integuments, in consequence of its being forced so strongly against them by the extensors of the foot. The displacement was of that description which I have called transverse, longitudinal, and angular. The fractured ends overlapped considerably, and the two portions of the tibia formed an angle, the salient point of which projected forward very much.

The limb was placed in the simple fracture apparatus, as soon as possible after his admission. The fractured ends were brought into apposition, and prevented from becoming displaced in the manner above-described. The tumefaction which followed the accident was considerable. As soon as it was sufficiently subdued, the limb was confined as for the second stage of fracture. The skin on the side of the instep having been slightly injured, it was thought advisable to keep this man in bed till the union was complete, which was found to have taken place at the end of the fifth week, with the fractured parts so accurately joined, that the situation of the fracture could scarcely be perceived.

This was one of the very worst cases of fracture of the leg, dividing the tibia downward and backward, that has fallen under my observation.

Eight days after the apparatus was removed the poor fellow, in getting out of bed, fractured the callus, by which the portions of the tibia were united. This rendered it necessary to re-apply the apparatus, which was done so as to press the fractured surfaces together, in the transverse and longitudinal directions. The man had some tenderness and pain in the fracture, which was purposely increased by the influence of the apparatus, in order to facilitate the uniting process. It subsided, however, altogether in the course of a few days, and the bone was again united firmly at the end of three weeks.

The pressure which it was deemed expedient to keep up by means of the apparatus, in the direction of the long axis of the bone, produced a slight displacement forward of the fractured end of the lower portion, the anterior edge of which could now be felt through the skin, by passing the finger over the fractured part.

It might not be improper to notice that, according to my experience, some slight displacement, similar to this, always occurs in very oblique fractures, when the fractured ends are forced together in the line of the long axis of the bone. This, however, if the case is well managed, is always trifling, for the most part, I think, not even perceptible to the eye, and is attributable to the influence of the pressure employed, for the purpose of keeping the fractured surfaces in tight apposition.

General inferences.

General Inferences.—1st. The deformity which frequently supervenes in cases of fracture of the bones of the leg is not to be considered as necessarily resulting from the physical condition of the injured parts; but as a consequence which is allowed to take place by the mechanical contrivances commonly employed, and which are not calculated to maintain the fractured ends in apposition and at rest.

2d. The mere existence of a simple transverse, or a slightly oblique fracture of one or both bones of the leg, is not enough to authorize the surgeon to confine the patient to bed during the whole period which the bones take in uniting; for, by the judicious employment of the apparatus which the author has introduced, the two primary indications, viz. apposition and local rest, might be as effectually answered when the patient is permitted to walk with the assistance of crutches, or ride in any easy spring vehicle; but, in all cases, the patient should be confined in the horizontal position till the inflammation and swelling, which result from the injury of the soft parts, is sufficiently subdued to allow him to leave his bed with safety. These are sometimes got under as early as the third day after the accident, and generelly within a week.

3d. The practice which the author recommends, might be followed with perfect safety to the patient, and without any danger of producing displacement, or non-union, if the management be properly conducted. The fractures treated in this manner unite more rapidly than those treated by any of the common means. This the author is disposed to attribute to the combined operation of three causes—namely, the proper coaptation of the fractured ends; the permanently local rest in which they are maintained by the apparatus; and the healthy action which is kept up in the system and in the fractured parts till the union is completed.

4th. In the management of very oblique fractures of the tibia, accompanied with fracture of the fibula, the author thinks it advisable to recommend patients to be confined to bed till the fibula is united; because he has, at present, some doubt whether the necessary extension and lateral pressure could be preserved with a sufficient degree of nicety to enable the surgeon to consider that the practice of allowing patients to be about in such cases, would be perfectly safe, and calculated to produce a more speedy and equally favourable union of the bones.

Treatment of oblique fracture into the knee-joint.

Oblique fractures of the head of the tibia into the knee-joint, require a different line of treatment from that recommended for the other fractures of this bone. The limb in these cases, must be placed upon one of my long fracture apparatuses, and maintained in the straight position. The condyles of the femur, when the limb is in this position, support the upper surface of the separated portion, and prevent it from being displaced upward. The surgeon, by the employment of a bandage and a pasteboard splint, must prevent it from being displaced in any other direction. Great care must be taken to maintain the natural line of the limb; for, if this be not done, the patient will probably remain lame for life, in consequence of the irregular bearing which the condyles make upon the head of the tibia after the union is completed. The limb being placed upon the apparatus, properly padded, the upper end should be confined to the pelvis by means of the pelvis-strap, the thigh to the thigh-part of the apparatus by straps passed over one splint placed in the front of the thigh, and the foot to the foot-board by the shoe appended to the apparatus.

SEC. 4.—*Fractures of the Bones of the Leg, accompanied with Dislocation of the Base of the Tibia, commonly called Dislocations of the Ancle-joint.*

Varieties.

It rarely, if ever happens, that a dislocation of the ancle occurs without fracture of one or both bones of the leg. There are four varieties of dislocation of the base of the tibia commonly enumerated, *viz.*, dislocation of the tibia inward, dislocation of the tibia outward, dislocation of the tibia forward, and dislocation of the tibia backward, which is an exceedingly rare variety. To these is added dislocation of the foot upward, that is, when the foot is driven up between the tibia and fibula. This is an accident which I have never seen. Sir Astley Cooper considers it to be an aggravated state of the internal dislocation.

ward—
mptoms.

The dislocation of the tibia inward, occurs more frequently than either of the other varieties. The base of the tibia, in this accident, is thrown inward off the astragalus, and the malleolus presses strongly against the integuments; the sole of the foot is turned outward, and the outer edge raised; there is a considerable depression on the outer side of the joint. When the parts are examined with the hand, the foot is found to move freely upon its own axis, and crepitus is generally observed in the line of the fibula, from two to three inches from its lower end. The pain and swelling which result from this accident are considerable.

ppearances
on dissec-
n.

Upon dissection, the internal appearances are found to be these. The base of the tibia lies on the inner side of the astragalus, "instead of upon its upper articular surface; and, if the accident has occurred from a person's jumping from a considerable height, the lower end of the tibia, where it is connected with the lower end of the fibula, is sometimes split off, and remains connected with the fibula, which is also broken from two to three inches above its lower end, and the broken end of the upper portion is carried down upon the astragalus, occupying the natural situation of the tibia." The lower portion of the fibula remains in its natural situation, with the portion split off from the tibia attached to it. The capsular ligament, where it is attached to the malleolus externus, and the three fibular-tarsal ligaments, remain entire, but the deltoid ligament is torn through, unless the inner malleolus be fractured, and also the inner side of the capsular ligament.

Dislocation of the base of the tibia inward, is sometimes occasioned by a fall to the ground, when the foot is fixed. In such cases, the body falls on the same side as the limb which receives the injury. It is sometimes produced by the foot becoming suddenly checked when a person is running violently, with the toe turned outward; but the most common causes are, falls or leaps from considerable heights, so that the Causes.

feet first strike the ground, and receive the force of the superincumbent weight of the body.

)utward—
ymptoms.

The dislocation of the base of the tibia outwards, is a much severer accident than that which I have just mentioned. "It is produced by greater violence, is attended with more contusion of the integuments, more laceration of ligament, and greater injury to the bones." The sole of the foot in this accident is thrown inward, with the inner edge turned upward, so that, if the foot were placed to the ground, the outer edge would come first in contact with it. The malleolus externus forces "the integuments of the ancle very much outward, and forms so decided a prominence, that the nature of the injury" is easily ascertained. "The foot and the toes are pointed downwards."

)issection.

In the dissection of the injured parts, "it is found that the malleolus internus is obliquely fractured, and separated from the shaft of the bone. The fractured portion sometimes consists only of the malleolus, at others the fracture passes through the articular surface of the tibia, which is thrown forwards and outwards upon the astragalus, before the malleolus externus. The astragalus is sometimes fractured, and the lower extremity of the fibula is broken into several pieces. The deltoid ligament remains unbroken, but the capsular ligament is torn at its outer part. The three fibular-tarsal ligaments remain whole in most cases, but when the fibula is not broken, they are ruptured. None of the tendons are lacerated. Internal hæmorrhages scarcely ever occur to any extent, as the large arteries generally escape injury."

Cause.

This accident is commonly produced by the wheel of a heavy carriage passing over the limb, or by jumping or falling from a considerable height, and pitching upon the foot, which is twisted inward when it comes in contact with the ground.

Forward—symptoms.

In the dislocation of the base of the tibia forward, the fore part of the foot appears much shortened, and the heel proportionably lengthened. The foot is fixed, and the toes are pointed downward. The lower extremity of the tibia forms a hard projection upon the upper part of the middle of the tarsus under the tendons, which it drives before it, and a deep depression is observed above the heel, accompanied with a preternatural curve at the back of the small of the leg.

issection.

Upon dissection, the base of the tibia is found to rest principally upon the upper surface of the os naviculare and os cuneiforme internum, quitting all the articular surface of the astragalus, except a small portion of its fore part against which the tibia is applied. The fibula is broken, and the fractured end of the upper portion advances forward with the tibia, while the lower portion, consisting of about three inches of the bone, commonly remains in its natural situation. "The capsular ligament is torn through at its fore part, the deltoid ligament is only partially lacerated, and the three ligaments of the fibula remain unbroken." Sometimes the tibia is split longitudinally through the inner malleolus.

ause.

This accident sometimes arises from the body falling backward while the foot is fixed, sometimes from jumping, or from being thrown out of a carriage in rapid motion, with the foot pointed forward and downward when it comes in contact with the ground.

Partial disloca-
ion forward—
ymptoms.

The tibia is sometimes partially dislocated forward. In these cases the base of the bone rests partly upon the os naviculare, and partly upon the astragalus. The anterior part of the foot is not so much shortened in appearance, nor is the projection of the heel so considerable as when the dislocation is complete. The fibula is broken, and, though the malleolus of the bone remains in its natural situation, the two fractured ends are carried forward with the tibia, at least they have been so in the cases I have witnessed. The internal malleolus is sometimes split from the point upwards, and one half remains in its natural situation, while the other is carried forward. Sir A. Cooper states, that "the foot is pointed downward, and a difficulty is experienced in the attempt to put it flat on the ground. The heel is drawn up, and the foot is in a great degree immoveable," but these are symptoms which have not hitherto fallen under my observation.

Consequence of neglect.

This accident is of course much less severe than either of those already mentioned; but, if it be neglected, or treated merely as a sprain, the union of the fractured fibula and the changes in the state of the tendons and ligaments, as well as in the articular surfaces, soon prevent the possibility of reduction, even under the most violent efforts that prudence could employ. Hence the deformity becomes permanent, but patients are able to walk after the lapse of some months with a limp, which arises in a great measure from an inability to bend the foot upon the tibia, as far as the parts in the natural state allow.

Partial dislocation backward.

I have not seen any case of complete dislocation of the base of the tibia backward. One case, however, of partial dislocation of the base of the left tibia backward, I had an opportunity of witnessing in St. Thomas's Hospital, in a man who was admitted under Mr. Travers.

Case—Symptoms.

The symptoms in this case were as follow:—The fore part of the foot was in appearance a good deal elongated and somewhat pointed downward. A considerable portion of the upper articular surface, was felt anterior to the base of the tibia. The heel appeared much shortened, and the foot could not be bent so as to form a right angle with the tibia. The pain experienced in the part was great; swelling moderate.

Cause.

The accident was occasioned by a fall upon his feet from the height of four stories, where he was painting the upper part of a house.

The force of the fall produced, also, a very severe compound fracture of the other leg, and some internal injury.

Treatment.

The parts were replaced in their natural situation, and the limb was laid upon the outer side between a pair of Sharp's leg-splints. On the third day after the accident, the base of the bone had again become dislocated. The man was now labouring under so much constitutional disturbance, that a slight effort only was made with a view to reduce the tibia, and this not succeeding, it was thought most expedient to wait for a more favourable state of the constitution, before any further attempt should be made. The compound fracture, however, took an unfavourable turn, and the man died in the course of a few days. Permission to examine the body could not be obtained.

Reduction.

In every variety of dislocation of the ancle, the patient should be placed in the horizontal position, and extension and counter-extension should be made by an assistant, with the limb in the bent position, while the surgeon directs the displaced bones into their natural situation. All that can be useful upon this subject, to a person acquainted with the anatomy of the parts, consists in general remarks. The remainder the surgeon will supply, as the peculiarities of any individual case may require. A good knowledge of the natural relative position of the bones of the ancle-joint, is necessary for the successful management of these cases. Without this knowledge, the most minute directions will be of no avail. The surgeon should bear in mind that the bones should be replaced in their natural situation, with as little violence as possible, and this too as soon as possible after the occurrence of the injury.

SEC. 5.—*The Common Modes of Treating Simple Dislocations of the Ancle.*

reatment—
ndications.

For the successful management of the various kinds of dislocation of the ancle, what do we require? Means to remove active inflammation and adequate mechanical support. The first object is to be attained by the application of leeches, sedative lotions, aperient medicines, &c., as in other injuries of similar violence; using them more or less vigorously according to the age and constitution of the patient, the degree of mischief sustained, and the condition of the parts to be restored. The instrumental aid required, is such as will enable us to apply effectual pressure and resistance in any situation, that the nature of the dislocation may indicate—such as will enable us to support the bones in their natural situation when they are once reduced, and, at the same time, prevent the foot and the leg from moving upon each other.

Remarks u the usual mo

If I am right in my opinion, these purposes cannot be obtained, by any of the usual modes of treatment, without endangering the proper restoration of the limb. The arguments which I advanced in a former Section, to show the inadequacy of the common mechanical contrivances made use of in the treatment of simple fractures of the leg, apply, for the most part, with equal force to them, when they are used in the treatment of dislocations of the ancle. Did the foot commonly become displaced equally in all directions in each variety of dislocation, there would indeed be no material difference in the operation of these means, when used in the management of simple transverse fractures of the leg and simple dislocation of the ancle, which I have said is accompanied with more or less injury to the bones. However, it is to be observed that, in loose transverse fractures of the leg, the fractured ends might become displaced backward or forward, or to the inner or outer side, which rarely, if it ever happens, in any variety of dislocation of the ancle. In each variety of these cases, the displacement almost always occurs in one direction, and this too commonly with much more facility than it takes place in transverse fractures of the leg in any direction, which is to be attributed to the smooth and lubricated condition of the parts which are naturally opposed to one another. When the sole of the foot gets a little turned to the outer side, the tibia readily slips off the astragalus to the inner side in dislocations inward; when the foot is a little extended in dislocations of the tibia forwards, the bone slips from the articular surface of the astragalus forward, &c. Hence it appears, that the position of the foot is a matter of the first importance in the management of dislocations of the ancle. It has lost its natural support and consequently requires well adapted mechanical aid to keep it in its place. But can this be accomplished with facility and certainty by any of the common means? I think not.

Mr. Sharp's splints.

We are recommended by a contemporary

author of great experience, to make use of a pair of splints with a lateral foot-piece, in other words Sharps' leg-splints with the addition of a lateral foot-piece to the inner splint, *(see* page 398*)* and of the same construction as that for the outer splint. When these splints are employed, the limb is placed between them as soon as the bones are reduced, and we are told to lay the limb on the outer side in the bent position, in dislocations outward or inward, and upon the heel in dislocations forward. Is this a plan of treatment, I would ask, calculated to support the parts in their proper position, and to restore the natural functions of the limb in either of these varieties? It is a plan which looks very plausible in theory, but it does not do in practice. Even in dislocation inward, which is the most simple variety to treat, the support which these splints afford is very precarious. The tibia slips off the astragalus in many instances, and, if not as frequently replaced, the consequences are permanent deformity and lameness. But it might be said that the splints should be applied with a sufficient degree of firmness to prevent the displacement of the tibia. Can this be done in the early—the most important stage of the accident, when there is usually considerable

Inadequacy in dislocations inward.

inflammation and tension, without infringing upon one of the soundest rules of surgery? Were this practice followed, it strikes me, that in some cases the consequences might be serious.

In dislocation outward.

In dislocations outward, the superincumbent weight of the limb is made to bear upon the parts which have suffered the greatest mischief. At a period when they are greatly swollen and in a state of active inflammation, a proceeding which must greatly increase the sufferings of the patient, with but little comparative advantage.

In dislocation forward.

In dislocations of the tibia forward, we find it expedient to force the foot forward, and at the same time to press the tibia backward, so as to keep it steadily upon the astragalus; but how are these indications to be answered? We are directed to make use of the same description of splints in the management of these cases also; but can these splints be applied so as to produce these effects? We are told to lay the limb with the heel resting on a pillow; but will the pillow, which yields in the greatest degree where it is most pressed upon, be sufficient to keep the foot forward, or will the tibia be prevented from slipping forward off the astragalus by this plan? The means appear to me so inadequate to produce the effects intended, that I cannot bring my mind to believe that these splints will generally be found sufficient for these purposes, however well padded and managed. It might be said that, if the foot be kept steadily placed, so as to form a right-angle with the leg, the articular surface of the astragalus will rest in the concavity of the base of the tibia, which will consequently be prevented from slipping forward. I grant that if the foot be so placed and so kept, displacement is not likely to occur when the base of the tibia is not injured; but every body knows that mechanical apparatus cannot with propriety be applied tight to parts in a state of active inflammation; and that, if the foot becomes slightly extended by the action of the gastrocnemii muscles, there is nothing in these splints to prevent the tibia from slipping forward, even when entire; and if a portion of the base be split off, I see no chance of supporting the parts in their proper relative position by this mode of management. The surgeon in these cases, is often put to his wits end to do the thing he wishes. He tries a variety of means that occur to him, or that his friends suggest: if one thing does not answer, he tries another;

if that does not succeed, he tries a third, &c.; always, of course, endeavouring to replace the parts into their natural situation, before the employment of each variety of mechanism. This, to say the least of it, must be attended with great suffering to the patient; and, after all the anxiety which every surgeon must feel under such circumstances, after all his endeavours and the patient's sufferings, what do we find to be the usual result? Most commonly the patient comes off with a deformed limb, and the surgeon with loss of reputation.

The difficulty of managing even partial dislocations of the base of the tibia forward, by any of the common means, is found to be considerable. Of this the following case is a striking instance.

Case. As a lady, residing at Paddington, was taking an airing in her gig, the horse became restive, and the servant losing all command over it, the animal ran away, and the wheel of the gig came in contact with the edge of the foot-path, and the lady was precipitated violently upon the stones, which she struck first with her feet. I was first called to see this lady about eight weeks after the accident. I found the tibia had been fractured longitudinally through the malleolus, but the fracture was not apparently complete. The largest portion of the base of the tibia was carried forward, and rested partly upon the articular surface of the astragalus, and partly anterior to it, leaving a fissure between it and the other portion, which remained connected in its natural situation. The fibula had been fractured about two inches and a half above the point of the malleolus, and the two fractured ends were carried forward, with the anterior portion of the tibia, so as to form an angle projecting forward in the situation of the fracture. The foot appeared shortened anteriorly, and the heel projected more than natural; there was, also, the usual concavity observed in these cases at the back of the leg.

I was requested to see this lady, for the purpose of replacing the parts into their natural situation; but it was now too late. The fibula had become united, and the tibia was confined to its new situation by strong adhesions. I was strongly urged to break the bone by some violent means, in order that the deformity might be removed; this, however, I refused to do, believing that no good effect would be produced. The late Mr. Cline, sen., was now called to see this lady in consultation, and agreed with me, that nothing could be with propriety attempted for the restoration of the parts.

This lady had the constant attendance of an experienced hospital surgeon before I saw her, and had been seen several times in consultation by men of the first eminence in the profession; but, notwithstanding their able advice and assistance, the result was permanent deformity and lameness.

Sec. 6.—*Author's Plan of Treating Simple Dislocations of the Ancle.*

Author's plan. The apparatus I employ in the treatment of simple dislocations of the base of the tibia, is that which I have recommended for the management of simple fractures of the leg. This will be found to enable the surgeon to answer all the indications which require to be answered by mechanical means. Whether the dislocation be inward or outward, forward or backward, let the limb be placed upon the apparatus, in the same way as I have directed for simple fractures of the leg *(see* Sec. 3), and this too as speedily as possible after the accident. When the parts are brought into their proper relative positions, and the apparatus is correctly applied, the surgeon has the whole of the limb under his command.

Dislocation inward.

In dislocations of the tibia inward, when the parts are reduced and the shoe properly adjusted, pass a four-headed roller round the lower part of the leg, within a short distance of the ancle-joint; place the unsplit part upon the inner side, and bring the ends together upon the outer splint, where they should be tied with a sufficient degree of firmness to keep the tibia upon the astragalus. If the base of the tibia happens to be fractured, it might be necessary to keep up extension, which can be easily accomplished in the same manner as I have directed for oblique fractures of the leg. When the corresponding ends of the four-headed roller are tied together, adjust the inner splint, and pass a strap round the limb over the splints and the apparatus just below the knee. Constitutional and local means should be had recourse to, to subdue the inflammation, as circumstances might indicate. If the application of leeches should be deemed advisable, the surgeon need only throw back the inner side splint, in order to have the injured parts sufficiently exposed to view for this purpose. Sedative lotions might be employed, with the splints adjusted in the manner I described, when speaking of simple fractures of the leg without dislocation.

ilocation
tward.

Should the dislocation be to the outer side, the four-headed roller must not be employed. If the surgeon should incautiously adopt this method, he would certainly deform the limb, by producing an unnatural approximation of the fibula to the tibia; an evil which we should be always very cautious to avoid. In these cases, partial pressure must be produced upon the outer side of the tibia, a little above the joint, by means of a piece of linen, rolled up and placed between the splint and its corresponding pad, so that the outer splint might exert its influence upon the tibia, through the medium of this short pad, which should not press at all upon the fibula. This pad must be made and employed in precisely the same manner as for oblique fractures of the leg, extending through the bone downward and outward.

islocation
rward.

When the dislocation is forward, the surgeon, having replaced the parts, must bring the foot up to form a right angle with the tibia, and regulate the elevation of the heel very carefully by means of the shoe, and keep back the base of the tibia upon the articular surface of the astragalus, by a four-headed roller, applied so as pass round the leg over the apparatus. The unsplit part should be placed in front of the leg, a little above the joint, and the ends brought together and tied at the side of the apparatus, sufficiently close to keep up a steady and gentle bearing upon the front of the leg.

The apparatus thus applied, effectually prevents the tibia from advancing forward, and the heel from being drawn backward, which cannot be done without great danger of repeated displacement, by any other apparatus with which I am acquainted. The side-splints should now be applied, in order to give lateral support to the leg and foot. These should be confined to the foot-board at the lower end, by means of tapes, and the upper ends should be kept in contact with the leg, by a circular strap, passed round the leg over them and the apparatus just below the knee.

When the limb is thus confined, we can apply any kind of lotion to it, without disturbing the injured parts; and by throwing back the side-splints, we have the limb sufficiently exposed to view for the application of leeches, should local depletion be required.

Dislocation backward.

In dislocations of the tibia backward, the principal indications evidently are, to keep the foot backward, and the tibia forward; and I am disposed to think that, in these cases, it will be better to omit the application of the shoe appended to the foot-board. Should such a case occur to me, I should place a short pad behind the small of the leg, between the large pad and the apparatus, of sufficient thickness to prevent the leg from bearing upon the apparatus at any other part; and then, when the dislocation is reduced, bring the foot up to form a right-angle with the leg, and confine it in this position to the foot-board and the lower end of the leg-piece, in such a manner as to prevent it from advancing forwards. This might be done by means of a roller. I should employ the side-splints in the same way as in other cases, for the purpose of giving lateral support to the foot and leg.

Second stage.

When the inflammation and tension that arise from the injury are got under, the limb might be supported as for a simple fracture of the leg, in the second stage, and the patient might be allowed to move the limb by means of a sling. Generally, however, confinement to bed will be required for a longer period than is usually necessary in the management of simple fractures of the leg without dislocation. The surgeon must be guided by the condition of the soft parts in every instance, taking care that he does not renew the inflammation in the joint, as this would tend to retard the recovery of the motions of the joint after the bones are united. Long experience has determined that the inflammation which arises, as a consequence of dislocation of the bones of the larger joints, *viz.* the shoulder, hip, and knee-joints, is speedily got over; and it does not appear that the existence of a fracture, accompanying the dislocation, makes much difference in this respect, provided that the fractured ends and the other parts are steadily supported in their natural position, and in a state of local rest. This will be illustrated by the following case.

A stableman, ætat. 24, employed by Mr. Smith, a coach and horse proprietor in my neighbourhood, had a dislocation of the base of the tibia inward, produced in an angry scuffle Case.

with another man. He stated that, when he was partly down, with the leg bent upon the thigh, and the foot greatly turned outward, his opponent threw himself violently upon the limb, and produced the dislocation.

The man was conveyed to his lodging, where I examined the limb. The fibula was fractured about two inches and a half above the point of the malleolus, and the limb presented all the usual signs of dislocation of the tibia inward. I now reduced the dislocation, and shortly after applied the apparatus in the manner I have recommended for this variety of dislocation in the first stage, and ordered the injured parts to be kept wet with a sedative lotion. When the limb was thus secured in the apparatus, it allowed of being turned from heel to side, and from side to heel, without producing any inconvenience. With so much facility was this done, and the practice so perfectly void of danger of re-producing displacement, that I permitted his wife to turn the limb from the heel to the outer side, and from the outer side to the heel, whenever he felt disposed to alter the position of the body. This she did frequently without occasioning the least increase of pain in the part, or any sensation of motion.

On the sixth day after the accident, the inflammation and tension having sufficiently subsided, I put up the limb in the manner I have directed for the second stage. I now fixed a sling to the apparatus, and told him to leave his bed, and commence the use of crutches. On the *ninth day* after the accident, he walked to my house, a distance of about a mile, which he did without exciting pain in the joint. He continued to use his crutches as he felt inclined, with the apparatus upon the limb, till the *twenty-first* day; at this time the apparatus was removed, and the man was suffered to bear upon the limb. To guard against any accident that might happen at this period, I applied a splint to the outer side of the limb, extending from the knee to the sole of the foot, and desired him to use his crutches, bearing lightly upon the limb as he walked. On the *twenty-fourth* day, he was able to walk, without crutch or stick, across the room. On the *twenty-eighth* day, all support was taken from the limb. He was now able to walk up and down stairs without any assistance. He laid aside his crutches, and availed himself of the use of a stick for a few days. At this time he had very little stiffness in the joint, and was able to walk freely upon a plain surface, having only a very slight limp. The relative position of the bones was natural, and the limb had already assumed its usual appearance, with the exception of a slight discolouration of the skin.

General inferences.

From the observations which the author has been able to make upon the treatment of simple dislocations of the ancle, he is induced to draw the following conclusions :—

1st. That the modes of treatment commonly had recourse to, cannot be depended upon, in the management of any variety of simple dislocation of the ancle. When any of these are resorted to, the patient is in great danger of being deformed for the remainder of his life, and this too after enduring a much greater degree of suffering, than necessarily arises from the nature of the accident.

2nd. When the plan which the author has recommended is properly conducted, it will be found that the injured parts may be kept with great facility and certainty in their natural position, and the cure completed in a shorter period, and with much less confinement, than when any of the usual mechanical contrivances hitherto introduced are employed.

CHAP. VI.

FRACTURE OF THE PATELLA.

SEC. 1.—*Causes, Nature, and Symptoms of Fracture of the Patella.*

FRACTURE of the patella is an accident which is frequently met with, and, like the fractures of other bones, might be produced by blows, falls, and by the action of the muscles inserted into it. This bone has not the appearance of one which we should think likely to be broken by the force of the muscles; but this is found to be a very frequent cause of fracture of the patella. Fractures from this cause do not happen when the leg is fully extended, but when it is slightly bent, so that the patella is brought down upon the end of the femur, and is acted upon at an angle by the muscles attached to it. The muscles act upon it when in this situation, with the advantage of a lever, and when they are made to contract violently, the patella sometimes snaps, and when it does so, the fracture is Causes.

commonly across the middle. When the bone is divided, the upper portion becomes more or less retracted, according to the degree of laceration which the capsular ligament and the tendons of the vasti have suffered.

Example.

This accident often takes place when persons in danger of falling forward attempt to recover their balance upon the limb. A person, for instance, going down stairs, may place the heel upon the stair, and at the same moment throw the body forward upon the limb a little bent; and finding that the foot is not properly upon the stair, he instantly contracts the extensor muscles of the leg violently to save himself from falling, and it is at that moment that the patella snaps.

Sometimes comminuted.

Sometimes the bone is broken into many parts. This variety of fracture is commonly produced by a fall upon the knee, or by a severe blow upon the patella, as from the kick of a horse.

Compound.

Fractures of the patella are occasionally compound, but this is an accident which I have never seen. It is one of very rare occurrence.

The transverse fracture is the most common variety. This is indicated by preternatural motion, when the base and apex of the bone are forced in opposite directions. Commonly, there is more or less separation of the two portions of the bone. This generally exceeds half an inch, and sometimes amounts to two or three inches. When there is any considerable contraction of the upper portion, the finger readily sinks between the fractured surfaces as far as the integuments will allow. When the retraction is very slight, the keen edges of the fractured surfaces may be readily felt through the skin.

Transverse most common —symptoms.

The fracture produces some inflammation in the joint, which commonly occasions an effusion, for the most part in sufficient quantity to cause the integuments to project over the breach of continuity, when the fractured surfaces are sufficiently separated.

Patients rarely suffer much constitutional disturbance from this injury.

Constitutional irritation.

Fractures of the patella commonly unite by the intervention of ligament. There are some specimens of patellæ, the fractured surfaces of which it is said have united by bone, but I have

Union.

not seen them. Ligamentous union sometimes holds the fractured surfaces so closely together, and with such a degree of firmness, that one portion cannot be perceptibly moved without the other; therefore it is sometimes difficult to determine, during life, as to the nature of the union by which the opposing surfaces are held together. It is of little consequence, however, whether the bond of union be bone or ligament, provided the ligament holds the fractured surfaces close together; but if the ligament allows of great separation, the power of extending the limb is diminished, and the patient is apt to trip and fall in the act of walking, and, by so doing, he not unfrequently breaks the other patella.

Difference in the degree of power.

It sometimes happens that a person with a ligamentous union, allowing the two portions of bone to separate from three to four inches, is able to walk without difficulty, though in other instances, where the separation is not greater, the limb cannot be straightened by the action of the muscles. I think it will be found that the difference in the degree of power which obtains in these cases, depends upon the situation of the fracture. The nearer the fracture is to the base of the patella, the less will be the inconvenience experienced in consequence of extensive separation of the upper and lower portions, and the nearer to the apex the fracture occurs, the greater will be the difficulty in extending the limb, when the upper portion is similarly retracted.

Sec. 2.—*Common Modes of Treating Fractures of the Patella.*

Early treatment.

The surgeon should bear in mind, that the retraction of the upper portion of a fractured patella, is occasioned by the extensors of the leg; and, as the rectus muscle has a great share in producing the retraction, we should take care to relax this muscle, in order to weaken its action as much as possible, consistently with the comforts of the patient. With this view, when we are called upon to manage a fracture of the patella in the recent state, we should place the patient in bed, with the trunk considerably raised upon pillows, as upon an inclined plane. The limb should be straightened, and placed upon a straight plane, inclining considerably towards the body. The origin and insertion of the rectus being thus approximated, sedative lotions should be applied to the knee, and if necessary leeches, and the bowels should be kept free by the operation of aperients. This treatment soon removes the inflammation sufficiently to allow of the application of mechanical means for the purpose of keeping the fractured surfaces in close approximation.

Indications.

The particular indications which should be attended to in the management of these cases, when the parts are brought into that condition, which enables them to bear the influence of apparatus, are as follow:—1st. To keep the limb in the straight position. 2nd. To flex the extensor muscles of the leg. 3rd. To keep down the upper portion of the patella, by resisting the action of the muscles attached to it; and 4th. To keep up the lower portion of the patella. All these indications should be answered, without obstructing materially the circulation of the limb. As the first and second of these indications are, as far as I know, always answered by the usual plans of treatment, I have to remark only upon the third and fourth.

The first point of inquiry then is, how far the action of the muscles which tend to retract the upper portion of the patella is resisted by the mechanical contrivances now in common use. Several methods have been resorted to for this purpose. In all the plans that I have seen, with one exception, there is something placed round the limb immediately above the patella, which acts as a girth, and consequently impedes the circulation, in proportion to the degree of tightness with which it is applied. This circular will have but little effect in preventing the retraction of the upper portion, if it be not acted upon in some way calculated to prevent it from being forced up the thigh, before that portion of the bone which it is intended to keep down. Surgeons have, therefore, found it expedient to attach to this circular, something which is made to act, either directly or indirectly, upon some part of the limb below the patella.

Sir E. Home's plan.

One method of treating fractures of the patella, consists in placing a circular bandage round the limb, immediately above the upper portion of the patella, and another below the head of the tibia. These two circulars are connected together, by a piece of bandage carried under both on each side of the limb. Each of these lateral pieces is intended to be tied sufficiently tight to resist the action of the muscles attached to the patella. The spiral application of a roller round the limb is advised, for the purpose of supporting the soft parts, which would otherwise become much swollen.

Remark.

When this plan is resorted to, the principal resistance to retraction is made by the head of the tibia and the inner condyle of the femur. My readers will perceive that, when the lateral pieces are drawn tight, their action tends to approximate the two circulars; but as the diameter of the *lower* circular, when applied, is too small to allow it to pass up over the condyles, the upper circular must be drawn down, and with it the upper portion of the bone. When the circulars are thus acted upon by the lateral pieces, no very great retraction of the base of the bone can take place.

Objections.

I object to this method of treatment—1st. Because of the great pain and swelling which it unnecessarily occasions in the knee. 2ndly. Because the upper portion of the bone cannot be kept down with a sufficient degree of nicety; and, 3rdly. Because it does not support the lower portion of the patella, which, when not acted upon by some force below, recedes towards the head of the tibia.

Supposed o jection—an swered.

It might be said, that by raising the lower circular above the head of the tibia, so that it might press upon the tendon of the patella, support would be given to the lower portion of the bone, and that, in this way, the third objection which I have mentioned might be got over; but, upon further reflection, it will be seen that this would give rise to an evil as great, if not greater, than that which it would be intended to obviate. The lower circular so placed, would act upon the ligament of the patella, and depress it between the condyles of the femur and head of the tibia; and, consequently, instead of forcing up the lower portion of the patella towards the upper portion, it would have the effect of causing it to recede in proportion to the curve which the lower circular gives to the ligament, by acting upon its anterior surface. Hence, it appears to me, that the objections which I first started, remain in full force.

Sir A. Coop plan.

Sir Astley Cooper recommends us to place a circular round the limb, above the upper portion of the patella *(see Fig.* 1), as in the plan which

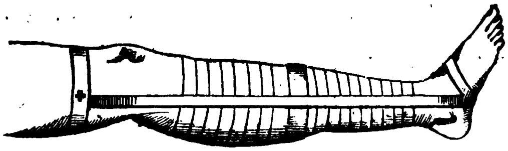


Fig. 1.

I have just described; but, instead of making the head of the tibia form the point of resistance, he refers it to the foot. This he does by means of a roller, which is fastened on one side to the circular, and then carried down to the foot, round which it is passed, and then brought up again, and confined to the circular on the other side of the limb. There is, also, in this mode of treatment, a bandage passed round the leg in a spiral manner, to prevent the tumefaction which the circular above the knee would otherwise occasion. The roller is not extended over the knee, where the patient sometimes suffers much in consequence of the obstruction which is given to the return of the blood by the circular placed above the joint. This is a great evil, and one which cannot be easily avoided, when this mode of treatment is strictly adhered to.

Objections. I do not see that the patella is better supported by this mode of treatment, than by that recommended by Sir E. Home. The objections which I have advanced against Sir E. Home's plan, I also hold against this advised by Sir A. Cooper. (*See* page 485).

Mr. Mogridge's plan. Another method of treating fractures of the patella has been lately introduced by Mr. Mogridge, of Devon, by which one of the objections mentioned in the two former plans is got over. The *Fig.* 2, is a skecth of the apparatus which he employs, and *Fig.* 3, the same applied as for a fracture of the knee-pan. That part of the instrument which presses upon the base of the patella, is made of highly-tempered steel, under which is placed a leather strap, and under this a hard-stuffed cushion.

Fig. 2.

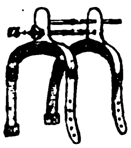
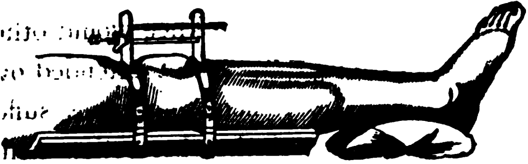


Fig. 3.



Application.

When the apparatus is used, one part of it is placed above the upper portion of the patella, and the other below the head of the tibia; and then by means of the screw, *a*, these two parts are approximated, and the upper portion of the patella is brought down. It does not appear that it was Mr. Mogridge's intention to act upon the lower portion of the bone at all; for, he says, that the head of the tibia and the condyles of the femur, should receive the pressure of the lower part of the apparatus, and consequently we may infer, that those must form the principal resistance to the action of the extensor muscles of the leg, through the medium of the apparatus. He says nothing about the propriety of supporting the lower portion of the patella; and, from what he has stated, it would seem that he was not aware of its importance. Indeed, as far as I know, this indication has been overlooked by every surgeon who has written upon fractures of the patella.

Remarks.

I am sorry to say, that I do not think this ingenious invention will be found generally useful. However well applied, there is danger of its giving rise to inflammation, or sloughing, or both, immediately above the base of the patella. I say one or the other, or both of these, because, sometimes, inflammation is produced by pressure, and at others, a part of the integuments is destroyed, without being preceded by inflammation; but inflammation ultimately comes on, and obliges the surgeon to remove the pressing body by which the slough was occasioned.

I may take this opportunity of remarking, that it is expedient to be always on our guard in applying pressure so as to act upon a bone covered by little more than the common integuments, even if the pressing body be softly padded; and if the pressing body be hard, as is the case in Mr. Mogridge's instrument, and exerts its influence upon a small space only, we are in great danger of producing sloughing, even if the pressure be continued but for a few days.

Objections.

I think the following objections might, with propriety, be stated against Mr. Mogridge's apparatus. 1st. The bearing which it produces above the patella is confined to so small a space that it would be likely to produce some serious mischief in the majority of cases. 2ndly. It does not support the lower portion of the bone so as to keep the ligament of the patella in a state of gentle extension. 3dly. If the apparatus were applied in such a manner as to act upon the lower portion, the principal point of resistance made to the extensors of the leg would, in this case, be thrown upon the apex of the patella, which, in all probability, could not be borne, without injuring the integuments by which it is covered. Further trials of Mr. Mogridge's apparatus, will, I am disposed to believe, be found to justify the remarks which I have felt it my duty to mention.

SEC. 3.—*The Author's Mode of treating Fractures of the Patella.*

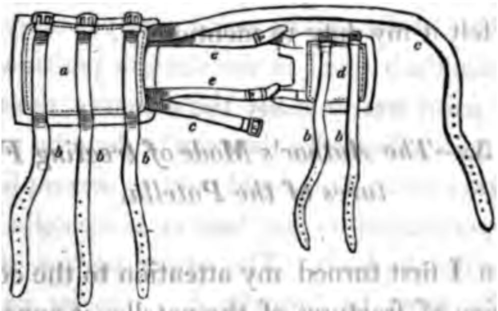
Author's plan.

When I first turned my attention to the consideration of fractures of the patella, it appeared to me that it would be advisable to act upon the base of the patella, and also upon a considerable portion of the muscles, whose action tends to retract it; which I conceived might be done by a modified pressure, kept up by some apparatus contrived for the purpose. This should be accomplished without subjecting the other muscles of the limb to the influence of painful pressure, and without producing any great interruption to the circulation of the limb.

Description of the author's apparatus.

With a view to act upon the base of the patella, and at the same time upon the lower ends of the extensors of the leg, I contrived a wide pad, *a*, *(see Fig.* 1, p. 493,*)* with straps *b*, so attached, that those which confine the pad to the limb, might allow of being buckled in such a manner as to compress the lower ends of the four muscles inserted into the patella, against that part

Fig. 1.



of the thigh-bone, over which they are situated. But to do this without compressing the other muscles, or interrupting the circulation, it was necessary that these straps should pass over some unyielding material placed at the back of the limb. Whatever is used for this purpose, should be wide enough to keep the straps from pressing laterally, so as to give inconvenience to the patient. The leg and thigh-pieces of my apparatus used for compound fracture of the leg, &c., offered themselves to my notice, as proper to keep the straps passed round the limb from pressing unduely upon any of the muscles which do not act upon the upper portion of the bone; and also to keep them from acting upon the vessels and nerves. They have likewise the effect of fixing the limb in the straight position, and at the same time possess a form upon which the limb lies easily.

The lower ends of the muscles inserted into the base of the patella being gently compressed, and the limb fixed in the straight position, the next point was to resist the action of the muscles more effectually than can be done by moderate pressure. This could only be accomplished by operating upon the base of the patella, in a line with the limb. The upper portion of the patella must be brought down to its natural situation upon the condyles, and fixed there, by making some other part of the limb form a point of resistance.

The head of the tibia and the condyles of the femur, first offered themselves as eligible parts for the resistance which it is necessary to give to these muscles in the longitudinal direction, in order to keep down the base of the patella; but reflection convinced me that I could not make them answer the purpose, without counteracting in a great measure another indication, which is to prevent the apex of the patella from receding towards the head of the tibia. The only point left, therefore, for effectually opposing the extensor muscles of the leg, was the sole of the foot. I accordingly had a strap, *c*, attached to the pad intended to lie above the patella in such a manner, and of sufficient length, to allow of being carried round the sole of the foot, and brought up and buckled on the other side. This strap is passed over the foot-board of the apparatus, opposite the base of the tibia, and is thus prevented from producing uneasy pressure upon the soft parts of the foot, and is at the same time kept in its proper situation by loops, under which it passes at the sides of the shoe.

The next object was to give a proper support to the apex of the patella, so as to prevent it from receding from the upper portion, as this is drawn down by that part of the apparatus already mentioned. It occurred to me that this might be done by another pad, *d*, placed below the patella. This pad should be confined with circular straps, *b*, sufficiently tight to make it act upon the apex of the bone when forced upward. This pad being properly constructed, I had to connect the upper and lower pads, so that the fractured surfaces might be brought into and retained in proper apposition. This I have succeeded in accomplishing by means of strong web straps, *c*, attached to the upper, and buckles of the proper size to receive the straps, fixed to the lower pad.

By the use of this contrivance, fractures of the patella might be better managed than by the employment of any other means with which I am acquainted. Every indication which I have noticed, as proper to be attended to in the treatment of fractures of this bone, might be more effectually answered, and at the same time, those evils which are observed to occur under the common modes of treatment might be more easily avoided.

Application.

When we apply this apparatus, the limb should be placed upon a splint, *a*, *(Fig. 2)*

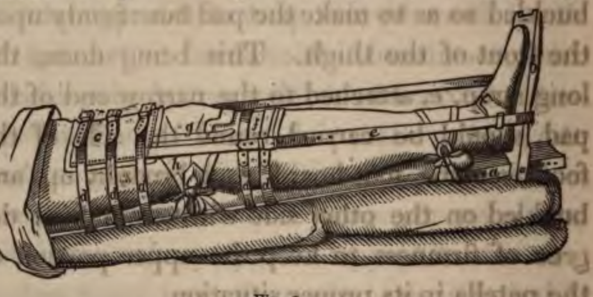


Fig. 2.

which should have a foot-board, *b*, attached to it, for the purpose of keeping the foot upright, which is done by means of a bit of bandage passed round it and the foot; and also to assist in steadying the lower part of the limb upon the splint. The lower end of the splint, with the limb resting on it, should be raised and

Large pad.

supported in an elevated position, so that it may incline towards the trunk. The back and shoulders should also be raised by means of pillows. The assistant should then be directed to push down the base of the patella to its proper situation, and confine it there with the fingers, while the surgeon applies that part, *c*, of the apparatus intended to fix it. The large pad used for this purpose should be placed upon the front of the thigh, with its narrowest end just above the base of the patella. The lateral straps, *d*, should be carried round the back of the limb over the splint, and brought up and buckled so as to make the pad bear firmly upon the front of the thigh. This being done, the long strap, *e*, attached to the narrow end of the pad, should be carried round the sole of the foot over the foot-board, and brought up and buckled on the other side with a sufficient degree of firmness to keep the upper portion of the patella in its proper situation.

Small pad.

The surgeon should now place the small pad, *f*, below the apex of the bone, and confine it to the limb in this situation by means of the lateral straps, *d*, which should be passed round the back of the leg over the splint, and buckled moderately close. The two pads should now be confined together by means of the web straps, *g*, and the corresponding buckles, with a sufficient degree of firmness to hold the fractured surfaces in contact.

Four-tailed bandage.

A strip of linen, *h*, the width of three fingers, and split at the ends so as to make a four-tailed bandage, should now be applied. The unsplit part of this should be placed between the pads, with the upper and lower edges a little under the corresponding ends of the pads. Two of the tails should now be carried round the back of the limb over the splint, and lightly tied to the corresponding tails on the outer side of the knee close to the splint. The object of this bandage is to give gentle support to the integuments covering the front of the knee. It also tends to prevent the anterior edges of the fractured surfaces from separating, while the posterior edges remain in contact. The foot should be confined to the foot-board, and the upper end of the splint to the thigh, by means of common linen rollers.

When the apparatus is properly adjusted, and the inflammation sufficiently subdued, the patient need not remain in bed; he may sit upon the bed, or get up and sit upon a sofa, with the injured limb resting upon the sofa, or sit upon a chair with the limb upon another chair of equal height; he should not be allowed to hang the limb down till the union is completed.

Case. A woman, admitted into St. Thomas's Hospital, under the care of Mr. Green, had the apparatus applied three or four days after the accident. The limb was kept raised upon pillows for a few days. The woman was then permitted to dress and sit upon her bed with the apparatus on, which she continued to do daily till the apparatus was removed, which was at the expiration of about five weeks from the time of the accident. At this time the fractured surfaces were found closely united together by the intervention of ligament.

The fracture was transverse, produced by a fall, and the separation of the fractured surfaces was considerable previous to the application of the apparatus.

CHAP. VII.

FRACTURES OF THE CLAVICLE.

SEC. 1.—*Causes, Nature, and Symptoms of Fractures of the Clavicle.*

Anatomy. THE clavicle is that bone which, in man, is found between the sternum and the scapula. It is something of the form of an italic *S*, and is connected at one end to the upper part of the sternum, and at the other to the scapula, by means of ligaments, which confine the motions of the clavicle within certain limits. An inter-articular cartilage is found between the sternal end of the clavicle and the sternum, which devides the joint into two cavities, each having a corresponding synovial membrane. This cartilage is thin in the centre, and thick at the edges, and allows the clavicle to move freely in all directions, as far as the ligaments will permit it. This joint forms the centre to the motions of the shoulder.

The connexion of the clavicle to the acromion of the scapula, is by means of a capsular ligament and several accessary ligaments. The ligaments which confine the scapular portion of the clavicle to the coracoid process of the scapula, are the conoid and the trapezoid. These ligaments limit the motions of the scapula upon the clavicle, and connect these bones firmly together.

Use.

The use of the clavicle is to keep the shoulder off from the chest, in order to give greater scope to the motions of the humerus. It does not immediately assist, as some suppose, in keeping the shoulder up. I cannot perceive that it has any influence in this respect, in any other way than by giving attachment to muscles which assist in suspending the limb. The shoulder is kept raised to its natural situation altogether by the action of muscles, and, if those muscles which have an influence in doing this lose their power of contraction, the position of the shoulder is immediately altered.

I had an opportunity sometime since, of verifying this observation, in the case of a young woman, admitted into St. Thomas's Hospital, under Mr. Green. When I first came to this person, I was much struck at her singular appearance. The shoulders had fallen so low, that they were deprived, in a great measure, of their natural roundness, and she complained of having lost the power of raising the arms to the head—in short, when unassisted; I observed that she could scarcely carry the humerus from the side. Upon examining the parts, I found that the scapula was turned upon its axis, and was altogether thrown out of its natural relative situation. The superior costa projected forward; the posterior occupied the situation natural to the superior, and the anterior projected backward. The muscles destined to support the point of the shoulder were thrown out of their natural line of action; and were, therefore, unable to sustain the shoulders at their proper degree of elevation. The relative position of the scapula and humeri, as the arms hung by the sides, was precisely that which they assume naturally when the arms are raised above the head; and, while each scapula and humerus continued thus relatively placed with respect to each other and the side, the deltoid muscle could not act so as to raise the arm. In continuing my investigation, I discovered that the antagonising muscle to the deltoid, namely, the serratus magnus, on each side, had lost its power of action, and that the paralytic state of these muscles was the cause of the malposition of the shoulders, and of her inability to raise the hands to the head. The superior costa of the scapula and the humerus approached to a straight line, by a simultaneous movement, when the deltoid was thrown into action, and consequently the arm was elevated only in a very slight degree. In order to ascertain that the loss of power in these two muscles allowed of the unnatural position of the shoulders, by which the arms were rendered almost useless, I placed each scapula in its natural situation, and then pressed with my fingers upon the posterior angle, so as to produce that influence upon the base of the scapula which is naturally produced by the serratus magnus; and now I observed that the shoulder had assumed its natural roundness, and the patient was able to raise the arm and carry it over the head, with almost as much facility as any one; but the moment the antagonising influence produced by my fingers was withdrawn, the shoulders dropped, and the arms became as useless as before.

Fractures of the clavicle are produced by external violence, such as falls upon the point of

Causes of fi ture.

the shoulder, falls upon the hand, blows upon the bone itself, &c.

lature. Simple fractures of the clavicle are not attended with danger to the life of the patient. The line of division varies in these as in the fractures of other bones. Sometimes the fracture is accompanied with but little injury to the soft parts. Sometimes the internal laceration is extensive, and now and then the fracture is compound, but this variety is very rare.

ymptoms. When a fracture of the clavicle exists in a recent state, the patient cannot raise the arm of the injured side to the head without pain; and, in some severe cases, is unable to do so at all. Crepitus may be produced with facility, when the fractured ends are brought into apposition, by rotating the point of the shoulder. There is commonly more or less displacement; but, when the fracture is transverse, this is occasionally so slight, that I have known the fracture overlooked, and the injury treated as a bruise of the soft parts. When displacement exists, it might be easily discovered, by drawing the finger along the upper and anterior surface of the bone. In fractures near the scapular end, the displacement is usually slight, even when the bone is obliquely divided; but in those which occur in the middle of the bone or near the sternal extremity, it is generally great, differing, however, in different cases, according to the direction and the degree of obliquity of the fracture, and the degree of internal laceration by which it is accompanied. When a fracture near the scapular end is attended with much displacement of the fractured ends of the bone, we may conclude that the laceration of the softer textures is unusually extensive.

In oblique fractures of this bone the line of division is generally downward and inward; and in these cases, the fractured end of the scapular portion is displaced downward, and that of the sternal portion upward. Now and then, however, the line of division is downward and outward, and when this happens, the fractured end of the sternal portion lies below that of the scapular portion. It has been stated that the sternal portion retains its natural relative situation, but this is by no means common in loose fractures. The fractured end of this portion is, in such cases, usually more or less elevated, by the action of the clavicular head of the sterno-cleido-mastoideus muscle.

Direction of Displacemen

Sec. 2.—*Usual Modes of Treatment.*

ndications. The indications to be answered in the treatment of fractures of the clavicle, accompanied with displacement are, 1st. To resist the action of the pectoralis minor, which I am disposed to think is the muscle whose action principally tends to bring the shoulder forwards, by some contrivance which might be made to keep the shoulders back without approximating them, so as to make the scapulæ turn upon their axes. 2d. To raise and support the shoulder on the injured side, so as to keep the scapular portion of the clavicle in a natural line with the sternal, and thereby resist the force of gravity and the action of the muscles, by which it is forced downward in a line with the long axis of the body. 3d. To resist the united action of the pectoralis major and latissimus dorsi, and other forces which tend to bring the arm and shoulder to the side, by some means calculated to keep the point of the shoulder at its natural distance from the chest. These three indications should be answered without pressing upon the broken clavicle, and without giving the patient more inconvenience than what necessarily arises from the confinement of the limb.

Usual mea

Stellated ba
dage.

Now let us see, how far these indications are answered by the means usually employed. We will take up first the stellated bandage. This is nothing more than a common linen roller applied round the shoulders, and crossed upon the back, so as to represent the figure ∞, placed horizontally. This is a very simple plan, but unfortunately it is too simple to be efficient. Those who attend strictly to the action of this bandage, will perceive that the only effect it can have, is that of keeping the shoulders back. This it does very imperfectly, for, when it is applied tight enough for this purpose, it soon gets upon the root of the neck, and approximates the points of the shoulders in an unnatural manner, instead of simply drawing them backward. The points of the shoulders are in a great measure suspended by the bandage lying across the neck; an evil which ought to be avoided, because it tends to force the fractured parts together in an unnatural line, and in this way to give rise to a deformed union. This effect of the bandage upon the shoulders, any surgeon may verify at pleasure, by having it applied upon himself, with the usual degree of tightness. Again, when this bandage is applied firmly, with the view to keep the shoulders from advancing forward, it soon excoriates the edges of the arm-pits, so that the patient is unable to bear its operation in a manner calculated to be of service, even according to the intention of those by whom it is employed, But these evils, though great in themselves, are trifling when compared to that which I will now mention. This bandage, in passing round the injured shoulder, presses upon the scapular portion of the broken clavicle. What is the mechanical effect of this upon the scapular portion of the bone? Evidently to press it lower, if possible, than it was drawn by the action of the fibres of the deltoïd muscle. Hence we might infer, that if the fracture should not be attended with much laceration, and consequently there should appear but little displacement, we have here one of the best modes of treatment that could be adopted, if our intention were to force the fractured surfaces away from one another, in the transvere direction, and thus to produce deformity of the bone. I need say nothing respecting the necessity of taking off this bandage frequently, in order to re-adjust it, nor of its inadequacy to answer other indications, enough having been stated, to show that it is a mode of treatment which ought not to be recommended.

The other two plans most recommended, are the mode of bandaging, advised by Desault, and the contrivance mentioned in Sir Astley Cooper's work on Dislocations, which I am told was invented by a German, whose name I am not acquainted with.

Desault's plan was, to place in the arm-pit a graduated hair or flock cushion, five or six inches long, and about three inches thick at the base. Two strings were attached to the corners of the base of the cushion. These strings were carried across the back and breast, and made to meet upon the opposite shoulder, where they were tied, with a view to keep the base of the cushion close up in the arm-pit. The cushion being thus placed in the arm-pit, and the fore-arm bent, Desault carried the elbow forward, upward and inward, pressing it forcibly against the breast. An assistant supported the arm in this position, while the surgeon placed one end of a single-headed roller, nine yards long, in the arm-pit, and then applied the bandage over the upper part of the arm and round the body, to the same situation. The arm and trunk were in this manner covered by the roller, as far down as the elbow, drawing the bandage more tightly the nearer it approximated to the bend of the arm. Another roller, nine yards long,

Desault's pl

was then applied, commencing by placing one end under the opposite arm-pit, whence it was carried across the breast over a compress, placed along the fractured bone, then down behind the shoulder and arm, and, having been passed under the elbow, it was again brought up and carried over the sound shoulder, round which it was passed, in order to fix the first turn. Desault then conveyed the roller across the back to the arm-pit, where it first began. The same plan was repeated till all the roller was spent. The bandages were secured by pins, whenever they promised to be useful, and the patient's hand supported in a sling.

This plan answered the indications which have been pointed out, but not without pressing upon the scapular portion of the clavicle. There are, however, some objections to this plan, which I think it my duty to mention. It will be observed, that Desault employed two rollers, each nine yards long. Now I have no objection to the quantity of bandage merely; but the objection which I entertain, arises from this length of roller, applied to a part which is constantly in motion. This circumstance occasions the rollers to get loose very soon after they are applied, and renders it necessary that they should be taken off and re-adjusted frequently. Besides this evil, it might be noticed, that if any single turn of the rollers gives pain, we have often no way of relieving the patient, without removing and re-adjusting them. From this we may infer, that Desault's plan is attended with much trouble; and if we go a little further, we shall perceive that this trouble is not followed by adequate advantages. Why? Because, as the rollers get loose, the shoulder is drawn into that situation which it would occupy if no bandage were employed. I object also to the application of a compress, thus bound upon the fractured bone, as unnecessary, and because it may be productive of much evil. Compresses thus applied often produce ulceration, and sometimes sloughing of the integuments over the fractured ends of the bone.

German apparatus.

The German apparatus depicted, as applied, in Sir Astley Cooper's work on Dislocations, and which is much used in our Hospitals, may appear at first view to offer every thing that is necessary, with the exception of a sling, for the treatment of fractures of the clavicle; but its operation is attended with a very serious evil, which seems to have been overlooked or attributed to some other cause. The padded strap which is passed round the shoulder, presses upon the scapular end of the fractured clavicle, and assists the fibres of the deltoid muscle, in no trifling degree, in displacing that portion of the bone. In almost every instance in which I have seen this apparatus employed, the fracture has united with considerable deformity. Fractures which would do well by the application of a simple sling alone properly adjusted, are in danger of uniting with much displacement of the fractured ends, under the operation of this contrivance. This apparatus keeps the shoulders back very well, but not without pressing upon the scapular end of the clavicle.

seful in some
ases,

Though I cannot recommend the use of this apparatus for fractures of the clavicle generally, there is one variety of fracture of the bone, in which it might be used with impunity; I mean fractures which divide the bone in a direction downward and outward. In these cases, by increasing the thickness of the pad, where it lies in the axilla, and keeping the elbow to the side, it might be employed with more advantage than any contrivance with which I am acquainted.

I also feel pleasure in being able to state, that I know of nothing so effectual as this apparatus, in cases of dislocation of the scapular end of the clavicle upwards, which is not an unfrequent accident. The pressure of the strap, passed round the shoulder, upon the scapular end of the clavicle, which proves so injurious in the management of a very large majority of the fractures of this bone, is here of the greatest benefit; and if the surgeon will assist the operation of the apparatus, by increasing the thickness of the pad in the axilla, and by keeping the elbow to the side, he will find no difficulty in maintaining the scapular end of the clavicle in its natural relative position.

In dislocations of the scapular end.

SEC. 3.—*Author's Mode of Treatment.*

Various trials, in which I particularly noticed the operation of the modes of treatment which I have detailed, convinced me that they fell far short of the advantages which I had been led to expect from them. I was, therefore, induced to investigate the principles upon which the treatment of fractures of the clavicle ought to be founded; and, having ascertained these to my own satisfaction, I at once discovered the

Authors' plan.

causes of failure, and now attempted to contrive a plan of bandaging the shoulders, so as to answer all the indications which I have observed, and at the same time to avoid all those evils which the surgeon has to contend with when he adopts any of the common means. The plan which occurred to me, and to which I have had recourse in public and private for about eight years, I shall now endeavour to describe.

Description.

The apparatus consists of two pads composed of thick flannel, covered with soft linen or calico, and of portions of linen or calico without padding. The pads must be wide enough to take in the points of the shoulders, and sufficiently long to pass nearly round them. The width for an adult is about six inches, more or less, according to the size of the shoulder. Care should be taken that each pad is wide enough to take in the point of the shoulder to which it is applied, and not so wide as to press injuriously upon the broken clavicle.

Pad for the injured side.

The pad which is intended for the injured side *(Fig. 1)*, should be composed of three layers of thick flannel, to the surface of which should be attached a roll of flannel, *a*, about

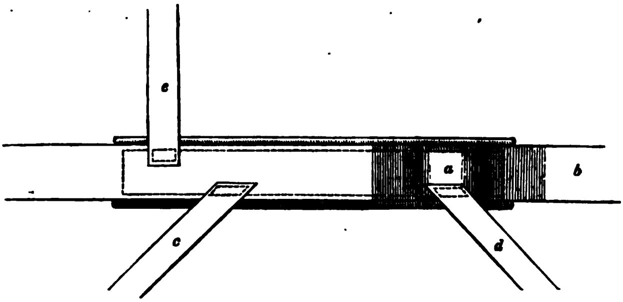


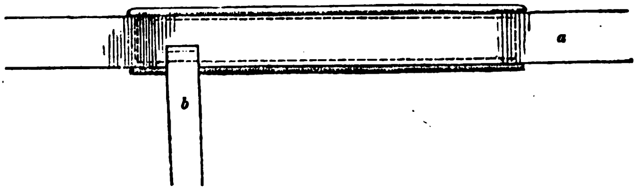
Fig. 1.

five inches long, and one inch and a half thick. This roll of flannel is intended to lie under the arm, having three layers of flannel intervening between it and the axilla, where the pad is applied. The three layers of flannel, and the roll of flannel having been cut out and properly tacked together, should be covered with soft linen or calico, and now a portion of linen roller, *b*, about twelve or fourteen inches longer than the pad, and of the same width, should be laid upon it on that side to which the roll of flannel is attached, and firmly sewed to it within half an inch from the side edges, and within about an inch from the ends. When the portion of bandage is properly placed, each end projects beyond the pad about six or seven inches. To this pad is sewed three other portions of linen, *c*, *d*, *e*, the uses of which will presently appear.

Pad for the sound side.

The pad for the sound side (*Fig.* 2), is made of two layers of thick flannel, covered with linen or calico. This pad, also, has sewed to its surface a portion of bandage, *a*, of the same size and length as that attached to the pad intended for the injured side, and has one portion of narrow roller, *b*, attached to it transversely.

Fig. 2.

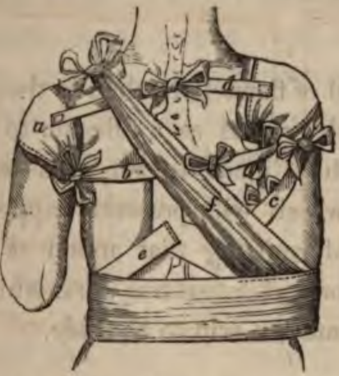


The remaining portions of this extemporary apparatus consist of a sling made of a common pocket-handkerchief, two pieces of common linen or calico roller, and a piece of linen or calico about eight inches wide, and long enough to extend round the chest over the arm, so that it might be tied.

Application.

In applying these pads, we commence by placing the thick part of that intended for the injured side in the axilla, (*Fig.* 1, *a*), taking care that the pad, throughout its length, is underneath the wide portion of bandage, *b*, attached to it, and by which it is confined. We then approximate the two loose ends of this portion of bandage behind the shoulder, and there tie them closely *(Fig. 3, a)*, so that

Fig. 3.



the point of the shoulder may be covered by the pad. Having proceeded so far, the surgeon should apply the other pad round the opposite shoulder, but more loosely. He should then take one of the portions of linen which he had procured, of the width of a common roller, and introduce it double, beneath the two circular portions in the situation seen at, *b*, and direct an assistant to place his hands upon the points of the shoulders, and push them back; the surgeon being, at the same time, placed behind the patient, with his knee against his back, should now pass one end of the roller through the loop formed at the double, and then tie it to the other with a sufficient degree of firmness, to prevent the shoulders from being drawn forward, which, as I have said, I believe is mainly accomplished by the small pectoral muscles.

Roll of flannel.

The roll of flannel attached to the pad for the injured side, serves as a fulcrum to the humerus, which is made to act as a lever, in the manner which will presently appear, for the purpose of resisting that action of the pectoralis major and latissimus dorsi which tends to approximate the arm to the side.

Pad must not be allowed to slide off the shoulder.

If the padded bandage be not wide enough to take in the point of the shoulder on the injured side, it will either slide down the arm when acted upon by the portion, *b*, which keeps the shoulders back, or will slide off upon the scapular portion of the clavicle, and thus produce the evil which we have complained of, as occurring when either the German apparatus or stellated bandage is used. In order to prevent this, it is not only necessary that the padded bandage should be made in proportion to the size of the shoulder, but, also, that it should be tied round the shoulder rather firmly.

There are three other ends of bandage hanging from the padded portion. *(See Fig.*1,p.515.*)* These are added, for the purpose of assisting to keep the pad more steadily upon the point of the shoulder, off which it might otherwise sometimes slip, even if the pad be made as wide as is necessary, to give it its proper bearing. Two of these ends, *c*, *d*, *Fig.* 1, are carried round the upper part of the arm, on the injured side, so as to meet behind, where they are tied *(see Fig.* 3, *c.) ;* the other, *e*, *Fig.* 1, is carried across the back, and is tied to the corresponding one which proceeds from the pad placed round the opposite shoulder, as is seen at, *d*, *Fig.* 3. These ends of bandage, thus confined together, have the effect of preventing the pad from slipping up, so as to press upon the broken clavicle injuriously, and also of guarding it from slipping down the arm, so as to render it less efficacious in keeping the shoulder in its place.

The next part that claims our attention, is the portion of bandage which acts upon those that encircle the shoulders, so as to keep the shoulders back. This cross-piece, *(b, Fig.* 3,*)* being drawn tight, if left to itself, gradually rises towards the neck, and, in proportion as it rises, it has the effect of causing the shoulders to approximate in the same way as the common stellated bandage. This alteration in the relative position of the shoulders, has sometimes the effect of forcing the scapular portion of the clavicle out of its proper apposition with the sternal portion, and must, therefore, be avoided. The evil here alluded to, may be easily prevented, by placing another piece of bandage, *e*, ***Fig.*** 3, the one which we are now considering, upon the cross-piece, *b*, and fastening it round the chest. This piece should be carried round the cross back-piece, and, after having been brought into contact, and fastened just below the cross back-piece, the two ends should be passed round the chest, and tied together in front. From the configuration of the chest, it might be presumed that this piece of bandage would gradually advance towards the upper part of the chest, and thus allow the cross back-piece to rise up upon the neck, as much as it would if no means were employed to keep it down. This, indeed, would happen, were it not for the antagonising operation of another portion of bandage, the uses of which I shall presently mention.

emarks. We have now got over the evils arising from the use of the German apparatus, and also those produced by the application of the stellated bandage, without losing any of the advantages proposed to be gained by their employment. By the plan which I have introduced, as far as it has been now described, the shoulders can be kept back without bearing upon the injured clavicle, without twisting the scapular portion out of its natural relative situation with the sternal, and without producing any excoriation of the parts which receive the pressure of the pads.

Sling.

The next indication which demands our attention is the elevation of the shoulder, which must be raised sufficiently to bring the scapular portion of the bone into a natural line with the sternal. This might be done by means of a common pocket-handkerchief sling, *f*, *Fig.* 3, the middle of which should be placed under the elbow, and the ends, carried obliquely across the back and chest *(see Figs.* 3 & 4*)*, should be made to meet upon the opposite shoulder, where they should be tied upon a pad with a sufficient degree of tightness to raise the shoulder of the injured side as high as the particular condition of the fracture may require. When the sling is applied in the common way, its pressure upon the broken clavicle not only gives pain, but tends very much to occasion a deformed union of the bone. By the mode which I have recommended, these evils are effectually got over, and the shoulder is supported at its proper degree of elevation with facility and ease.

The arm to be kept to the side.

We have now discovered means for keeping the shoulder back, and raising it without pressing at all upon the injured bone; and, in so doing, have succeeded in answering two indications; but there is a third that requires our attention, if we wish to bring the case to a favourable issue. I have said that the pectoralis major and latissimus dorsi muscles are much concerned in approximating the shoulder and arm unnaturally to the side, by which the fractured ends of the clavicle are made to overlap. The action of these muscles must, therefore, be resisted. Now, the reader will see more clearly the use of the roll of flannel attached to the pad for the injured side. This roll of flannel is used of sufficient thickness to keep the arm off from the side; but, as the humerus moves freely in the glenoid cavity of the scapula, it has but little effect upon the point of the shoulder when the arm is suffered to hang loosely by the side, or even when the shoulder is raised by means of the sling; but we can easily make it efficacious, by causing the humerus to act upon it as a lever upon a fulcrum. Suppose the roll of flannel to be thick enough, as it always should be, to throw the humerus off from the side of the chest; then, the moment you press the humerus to the side, you act upon the point of the shoulder with a long lever, the fulcrum to which is the roll of flannel in the arm-pit. Thus, the point of the shoulder might be carried off to a natural distance from the side with the greatest facility, and the fractured ends of the bone prevented from overlapping. We have, therefore, only to keep the arm in this situation, and we shall find our third and last indication most effectually answered. This is done, by placing the wide piece of linen or calico round the body over the lower part of the arm, in the manner seen in *Figs*. 3 and 4, and tying it rather firmly in front, at, *a*, *Fig*. 4.

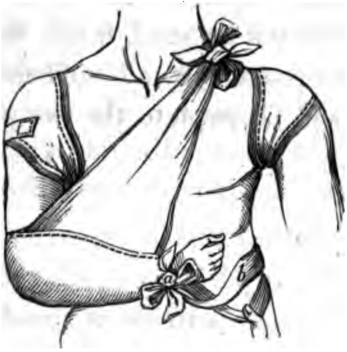


Fig. 4.

One end of this wide bandage, before it is fastened to the other, should be carried under that portion of bandage which was previously passed round the chest *(see e, Fig.* **3**, and *b, Fig.* 4*)*, and used for the purpose of preventing that portion, which lies across the back, from riding up upon the neck. The connexion of these two portions of the apparatus, in the manner I have mentioned, has two advantages. The wide portion, which is employed to keep the arm to the side, and which, in some measure, also supports the fore-arm when thus connected with the other, prevents it from sliding up upon the chest in a way which would occasion it to get loose and inefficient, and at the same time the portion of bandage, which is used to keep down the piece placed across the back, operates so as to support that which keeps the humerus to the side, and prevents it from slipping down, and loosing its hold upon the fore-arm. The hand, which should not be used, might be kept in a comfortable position, by a bit of bandage passed round it, and fastened to the two portions last described.

Recapitulation. This mode of treatment, then, for fractures of the clavicle, requires two pads properly fitted up, three loose portions of bandage, and a sling. The pad for the injured side has five ends of bandage hanging to it, and that for the sound side only three. There is a piece of linen roller to act upon these, so as to keep the shoulders back; another to keep this in its proper situation; and a third, a wide piece of cloth, to keep the lower end of the humerus to the side. This piece should be applied over the sling and tacked to it, for the purpose of being retained in its proper situation.

I have now given a description of, and detailed the mode of applying, the different parts of the extemporary apparatus, which, for the want of a better name, I call a clavicle-bandage; and I have endeavoured to put the reader in possession of the operation of this bandage, when properly made and applied. This mode of treatment, which I recommend with great confidence, may at first appear complicated; but I am not aware that any part can be with propriety omitted.

Action easily regulated.

There is yet one point respecting the bandage to which I wish to call your attention, and which, in my estimation, is one of no trifling nature; I allude to the facility with which the surgeon may increase or diminish the action of any one or more of its parts, without deranging the whole, or even without the necessity of removing a single portion. For instance, suppose you find, after you have applied the apparatus, that the injured shoulder advances a little too much, you have only to tie that portion which confines the shoulders back a little tighter, in order to bring the shoulder back as far as may be necessary, without the trouble of untying any other part; again, if you perceive that the scapular portion is not quite so much elevated as the sternal, you have only to shorten the sling, and this evil will be immediately removed; or if you observe any overlapping of the fractured ends, you will find that, by drawing the broad piece of linen placed round the body over the arm rather closer, this derangement of the fractured ends will be remedied. If you find that it is not, you may be sure that the roll of flannel placed in the axilla, is not sufficiently thick to prevent the humerus from pressing against the side; and you must, therefore, increase its thickness, before the circular body-piece of linen can be made to have its due effect. To do this, it is advisable to remove the padded portion from the injured shoulder. But this is a degree of trouble arising from want of attention in the first instance, and which may, with proper care, be easily prevented. When superintending the construction of this apparatus, the surgeon should well consider the size of his patient, and remember that the roll of flannel intended to act as a fulcrum, should always be sufficiently thick, to throw the arm off somewhat from the side, and to prevent it from pressing against the side under the action of the portion of linen by which it is confined.

Powers tending to produce deformity resisted.

The clavicle-bandage once properly applied, enables the surgeon to resist the action of all those powers which tend to produce displacement, and puts the fractured bone entirely under his control, without being productive of any of those evils which, I have endeavoured to show, arise from the usual modes of treatment. I am not prepared to say that every fracture of the clavicle, treated in the manner which I have thought it expedient to advise, admits of being united without deformity; but, I am fully convinced that, if such cases should occur, they will be found very rare. I have had this bandage in use now about eight years, and, in the course of this time, I have used it in a large number of cases, many of which have occurred in St. Thomas's Hospital. The results of these cases have been very satisfactory to myself, and to those surgeons by whom the treatment was witnessed. The surgeon may rest assured that, if he will take care to see that the different parts are properly made, properly applied, and properly managed, the operation of the bandage will not deceive him. Let him try it in the worst cases, after all other means have failed—for this is the way to prove the value of any new contrivance—I say let him try it after all other means have failed, and he will then have proof, from his own experience, of the command which it gives him over the fractured bone; the facility with which the treatment is conducted, and the comparative degree of comfort with which it might be worn.

I will mention one case by way of illustration.

Case.

A powerful man received a blow on the point of his shoulder, which produced a loose oblique fracture of the clavicle, dividing it near the middle. I saw this man on the fourteenth day after the accident. At this time the surgeon in attendance, had tried all the means in common use, and also an invention of his own, without being able to keep the fracture in any thing like tolerable apposition. The man had suffered greatly from the operation of the plans which had been adopted, and now his arm-pits were much excoriated. The fractured ends of the bone over-lapped about an inch, but no union had taken place. I applied the padded bandage in the manner I have described, and at the end of three weeks from this time, I had the pleasure to find that the bone was perfectly united, and so even and natural was it joined, that at the expiration of twelve months, when the superfluous callus was absorbed, it could scarcely be discovered by a careful examination which of the clavicles had been broken. The bandage retained its situation during the uniting process, and required only to be tightened from time to time as the linen stretched under the strain that was made upon it. It was worn with ease to the patient, and the excoriated parts, being properly protected from its action, soon healed.

Remark: Here it might be remarked, that a bandage which allows the excoriated edges of the arm-pits to heal, while it is in full operation, is not likely to produce excoriation itself unless misapplied.

CHAP. VIII.

FRACTURE OF THE SCAPULA.

THE parts of this bone most frequently fractured, are the acromion, the neck, and the inferior angle.

Of the acromion.

When the acromion is broken off, the roundness of the shoulder of the injured side is lost, and, part of the attachment of the deltoid muscle being separated, the head of the os humeri sinks towards the axilla, as far as the capsular ligament will permit. On carrying the finger along the spine of the scapula, a depression is felt just at the junction of the clavicle with the acromion, which arises from the displacement of the fractured portion. The distance from the sternal end of the clavicle, to the extremity of the shoulder, is diminished on the injured side. If the arm be forced upward in a line with the chest, the rotundity of the shoulder will be restored, but the deformity returns again, as soon as the arm is suffered to fall. If the arm be rotated while it is raised, crepitus can be distinctly perceived at the point of the shoulder and along the superior portion of the spine of the scapula. The patient, as soon as the accident has happened, feels as if his arm were falling off. The shoulder drops with a great sense of weight, and the patient feels but little power to raise the limb.

Treatment.

Fractures of this part of the scapula may unite by bone, but they generally unite by the intervention of ligament, in consequence of the difficulty which exists in producing adaptation, and in preserving the parts in a state of quietude during the period required for union. The os humeri should be raised so as to bring the displaced portion of the fractured bone into its proper situation, and supported so as to prevent the acromion from dropping. The deltoid muscle should be relaxed, which may be done by means of a cushion, placed between the elbow and the side; for if the elbow be brought close to the side, the broken acromion is further separated. The arm should be raised, and the elbow carried a little backward, and then confined by a roller passed round the chest. The limb should be kept firmly fixed in this position for three weeks.

Fracture of the neck of the scapula.

This injury divides the neck of the bone immediately opposite the notch of the superior costa, by which the head of the bone becomes detached, and falls into the axilla. The shoulder drops, and there is a hollow below the acromion, from the sinking of the deltoid muscle. The head of the os humeri, with the head of the scapula, can be felt in the axilla.

Displacement.

The degree of deformity which accompanies this injury, "depends upon the extent of laceration of a ligament, which passes from the under part of the spine of the scapula to the glenoid cavity, and which is not generally described in anatomical books. If this be torn, the glenoid cavity and the head of the os humeri fall deeply into the axilla, but the displacement is much less if this remain whole.

Symptoms.

"The diagnostic marks of this accident are three:—1st. The facility with which the parts are replaced. 2dly. The immediate fall of the head of the bone into the axilla, when the extension is removed. 3rdly. The crepitus which is felt at the extremity of the coracoid process of the scapula, when the arm is rotated. The best method of discovering the crepitus, is for the surgeon's hand to be placed over the top of the shoulder, and the point of the fore-finger to be rested on the coracoid process; the arm being then rotated, the crepitus is directly perceived (provided the fractured parts be in apposition), because the coracoid process being attached to the glenoid cavity, and being broken off with it, although itself uninjured, the crepitus is communicated through the medium of that process."

Treatment.

"The treatment of this fracture consists in attention to two principles. The first is to carry the head of the os humeri outwards, and the second to raise the glenoid cavity and arm." Both these indications are easily effected by the employment of my clavicle-bandage *(see* page 514). The bandage should be applied in the same manner as in fractures of the clavicle, with this exception, the shoulder will not require to be carried backward, because the clavicle remains entire, nor should the bandage be made so wide as to press upon the broken portion of the bone.

"The time required for recovery in these accidents, in the adult, is from ten to twelve weeks; in the very young, all the motions of the limb are restored in a shorter period, but it is a long time before the limb recovers its strength." *

ractures of he body of the one.

Fractures in different directions through the spine and body of the bone occasionally occur. They are commonly attended with crepitus, and are for the most part easily discovered.

reatment.

"When the scapula is fractured longitudinally or transversely, it is merely necessary to fix the arm to the side by means of a bandage, which includes the arm from the shoulder to the elbow. Thus the motions of the shoulder, which are only concomitant with those of the arm, are prevented.

nferior angle.

"When the inferior angle is broken, and drawn downward and forward by the serratus major anticus, the scapula must be pushed towards the fragment, by pushing the arm itself inward, downward and forward, where it is to be kept with a roller. The fragment is also to be kept backward as much as possible, with compresses and a roller. The arm is to be supported in a sling."

---

* Sir A. Cooper on Dislocations.

CHAP. IX.

FRACTURES OF THE HUMERUS.

SEC. 1.—*Causes, Nature, and Symptoms.*

Fractures of the cervix.

Fractures of the humerus may take place from external violence, or from the action of the muscles of the limb. When they occur through the neck of the bone, where it gives attachment to the capsular ligament, it is sometimes difficult to ascertain the precise nature of the injury. In these cases the ligament is occasionally so much torn as to allow of the escape of the head of the bone from the glenoid cavity of the scapula.

Case.

Through the politeness of Mr. Travers, I had an opportunity of witnessing the inspection of the shoulder of a man who had the neck of the humerus fractured by a fall; and the parts presented the following appearances:—The head of the bone was broken off at that part which, in anatomical language, is called the neck, forced from its natural situation, and was found lying in the axilla. Both tubercles were broken from the shaft of the bone, and were drawn in opposite directions. The shaft of the bone was drawn up by the action of the muscles, so that its upper end came in contact with the acromion scapulæ. Though two months had elapsed from the time of the accident, there was not the least appearance of an attempt at restoration. The man died from a rupture of the heart, and the preparation of the shoulder may now be in the possession of Mr. Travers.

This man was a patient in St. Thomas's Hospital, where I had an opportunity of seeing him frequently during life, and of observing the symptoms of his accident, which were these: —The least attempt to raise the arm, even passively, gave him great pain. The upper end of the shaft of the bone, occupying the natural situation of the head, prevented the deltoid muscle from falling in, so as to present the usual appearances of fracture of the neck when accompanied with much laceration of the soft parts. This part of the bone could be distinctly felt through the muscles, moving when the arm was rotated, and giving the same kind of sensation to the fingers as when the head of the bone is made to roll under them. When the bone was forced up against the acromion, and, at the same time, rotated, the motion gave great pain, but was not accompanied by crepitus. When the bone was drawn down gently, and then rotated, a crepitus was discovered, which sometimes gave that kind of sensation to the fingers which we should expect to experience by rotating the head of the bone in a bed of rough pebbles. A preternatural fulness was felt in the axilla, which gave the sensation of crepitus when pressed towards the humerus, at the time this bone was rotated. Considerable tension continued round the joint to the period of his dissolution.

Occur in ol
people.

The cases of this kind that have fallen under my observation have occurred in old people.

Fractures b
low the tub
cles.

Fractures often occur immediately below the tubercles. These, when complete, are usually easily discovered. When the fragments are brought in a line, and the head of the bone fixed, the lower portion should be gently raised, so as to bring the ends in contact, and then, by rotating the lower fragment, crepitus may be felt.

At all ages.

I have seen these cases in the young, the old, and in the middle-aged.

Fracture in the middle.

But the most common situation of fracture of the humerus is through the middle of the bone. When the upper portion is fixed, crepitus may be felt in the same way as in fractures through the bone just below the tubercles. A joint-like motion may be perceived by moving the lower portion in different directions.

At all ages.

Fractures through the middle of the bone are common at all ages.

Above the condyles.

Sometimes, fractures happen immediately above the condyles. The appearances in these cases are the same as those of dislocation of the ulna and radius backward, but often much less strongly marked. Extension removes the appearances of dislocation, but these appearances return as soon as the extension is discontinued. Usually a crepitus may be felt when the fore-arm is moved so as to produce a rotatory motion between the upper and lower portions of the fracture.

At all ages.

This accident happens at all periods of life;

the state of the bone, however, renders children much more liable to it than persons more advanced in age.

Of the inner condyle.

Fractures frequently take place through the inner condyle. The fracture usually extends in an oblique direction from the trochlea of the os humeri to just above the inner condyle. The symptoms of this accident are thus described by Sir Astley Cooper:—"The ulna projects backward from having lost its support. If the fore-arm be extended, the hand becomes twisted inward towards the side; but upon flexion these appearances are removed." These symptoms, with the crepitus which might be felt upon "bending and extending the arm," are diagnostic of this injury.

Of the outer condyle.

Fractures of the outer condyle occasionally occur. The fracture usually extends from the trochlea obliquely outward to just above the outer condyle. Sometimes a small portion of the condyle only is broken off. In these cases crepitus may be felt by moving the fore-arm upon the humerus; or by moving the condyle while the body of the humerus remains fixed.

In taking a general survey of the diagnostic marks of fractures of the humerus, as they occur in different situations, I have confined myself to the enumeration of such as may be considered pathognomonic. The usual collateral symptoms are pain and swelling, and sometimes displacement.

isplacement.

Fractures of the humerus, accompanied with any considerable laceration of the soft parts, are usually attended with derangement of the fragments.

elow the tu-
ercles.

When the fracture passes through the bone just below the tubercles, the deformity is produced by the action of the pectoralis major, latissimus dorsi, and teres major; which, being attached to the lower portion, near its superior extremity, draw it first inward and then upward. In the last direction it is powerfully forced by the action of the biceps, coraco-brachialis, and long portion of the triceps. The superior portion will be directed a little outward by the action of the supra-spinatus, the infra spinatus, and teres minor, which make the head of the bone perform a rotatory motion in the glenoid cavity of the scapula.

bove the in-

When the fracture occurs between the inser-

sertio
deltoi

tion of the pectoralis major and the insertion of the deltoid muscle, the inferior portion is first drawn outward, and then upward on the external side of the superior. The cause of this position of the fragments is evident. The adductors draw the upper portion to the chest; and those muscles which arise above, and are inserted below the fracture, draw up the lower portion on the outer side of the upper.

Below

Fractures just below the insertion of the deltoid muscle, are often attended with great derangement of the fractured ends. The deltoid muscle raises the upper portion; and the lower is drawn up on its inner side. Sometimes the fractured surfaces are separated considerably from each other. In a case of oblique fracture that has lately come under my observation, the distance between the fractured ends of the bone allowed the finger, carrying the integuments and a portion of muscular fibre before it, to lie between them, when the arm hung steadily in the bent position by the side.

Near t
end.

Fractures near the lower end of the bone, when oblique, are subject to great derangement of the lower portion; but when transverse, the displacement is not so great as in other situations—an effect which is to be attributed to the greater size of the bone at this part, and to the retentive power of the muscles arising from its surface.

the inner ndyle.

In fractures of the inner condyle, extending through the bone in an oblique direction, the position of the broken portions is influenced by the position of the ulna with respect to the humerus. No displacement will appear when the arm is bent, but in the extended position the displacement will be evident.

the outer ndyle.

When the fracture extends obliquely through the outer condyle, the broken portion may be drawn a little backward by the action of the anconeus.

ot always dis- aced alike.

Though I have here mentioned the more common varieties of displacement in fractures of the humerus, it is not to be considered that the fractured ends will always be found deranged in the same direction even in fractures that may seem to be similarly situated. It will immediately appear, that the direction in which the different portions become displaced, is greatly modified by the direction which the fracture takes through the bone. The degree of laceration of the soft parts will also contribute to influence the direction of the fragments in whatever situation the fracture may occur. Suppose, for instance, that a fracture extends obliquely downward and inward through the lower portion of the bone, what would be the probable direction in which the lower fragment would become displaced? Would it be drawn up on the inner side of the upper portion? Certainly not; because the fractured surface of the upper portion lying on its inner side would prevent the muscles from drawing it up in that situation; it would therefore be drawn up on the outer side of the upper portion, inclining a little forward or backward at the seat of injury, according to the degree of flexion or extension of the fore-arm, and the degree of laceration of the soft parts.

SEC. 2.—*The usual Mode of Treating Fractures of the Humerus.*

In the treatment of fractures of the humerus, the curative indications which require to be answered by mechanical means may be summed up under two heads:—1st. To fix the fore-arm and humerus at a right angle, so that any motion given to them may have its centre in the shoulder-joint. 2nd. To prevent the fragments when once placed right from being deranged by the involuntary action of the muscles, or by any accidental motion passively given to the limb below the fractured part.

Usual plan.

The common plan of treatment consists in the application of four padded splints, long enough to extend from the shoulder to the elbow, and confined to the limb by means of tapes or a bandage; and in the use of a sling to support the fore-arm at a right angle with the humerus.

In my observations upon simple fractures of the lower extremity, I endeavoured to shew that a principal object, in the treatment of these injuries, should be to fix the whole limb by some unyielding substance, continued from one end to the other. Let us now see how far the same principle will apply in the treatment of fractures of the humerus.

Advantages in the management of fractures of the humerus from the situation of the bone.

Like the thigh-bone to the pelvis, the humerus is articulated to the scapula by a ball and socket-joint. The former is connected to the tibia by a joint that has a hinge-like motion;

and in this respect it does not differ from the kind of joint that connects the humerus to the bones of the fore-arm. They are also both acted upon by powers which tend to displace the fragments of a fracture in the transverse and in the longitudinal direction. Now, as these two bones are connected by the same kinds of joints to the bones above and below them, and as they are both liable, from the action of muscles attached to different parts of their surfaces, to be displaced in various directions when broken, we may ask what makes the great difference in the treatment of a fractured humerus and a fractured femur? The humerus, it will be seen, is so situated, with regard to the other parts of the body, that it may be allowed to hang by the side when fractured; and that, when placed in this position, the gravity of the parts below the fracture serves materially to prevent displacement in the longitudinal direction. In the arm, too, the muscles are so thin that splints act more effectually in preventing lateral derangement of the fragments. The thigh, on the contrary, is so placed, that it cannot be kept in a depending state during the cure of a fractured femur. Here we see that the pendent position of the limb, in the treatment of a fractured humerus, is lost in the treatment of a fractured thigh. Again; the muscles surrounding the thigh-bone are so thick and powerful, that transverse displacement is easily produced; and, when the fracture is attended with much laceration, this cannot be prevented by any means which do not fix the whole limb. Thus we see, that from the position of the arm with respect to the trunk, and from the thinness of its muscles, we derive advantages in the treatment of a fractured humerus, from which we should conclude, even without a knowledge of the fact, that the treatment of fractures of this bone is far more easy than the treatment of fractures of the thigh.

There is one point, in the consideration of these accidents, which applies equally, or nearly so, to fractures of the humerus, treated in the common way, and to fractures of the femur; and this is the rotatory motion produced in the site of fracture, by powers usually independent of the muscles of the limb. This our curative means should prevent, for it is a matter of no trifling nature as it regards the ultimate result. It is certainly more likely to take place in a fractured femur than in a fractured humerus, from the greater weight and greater length of the lower limb; but still the causes which produce it in the one will also tend to produce it in the other. The short splints made use of in the treatment of fractures of the humerus, and frequently in the treatment of fractures of the thigh, have no power to prevent this motion from taking place. This, I think, will appear from the first experiment related in my observations on fractures of the femur. *(See* page 297.*)*

Experiment.

If it need further illustration, it may be shown by two circular rods of any given length, with two of their ends brought into contact and surrounded by a piece of tube just large enough to admit them. If we take the projecting end of either of these rods, placed as I have mentioned, we shall find that, by carrying it out of a line with the tube, we shall move the rod which projects at the other end of the cylinder. But if we place the whole upon a plain surface, and attempt to rotate both the rods by the motion given to one, we shall perceive that the rod to which an impetus is given rotates freely within the calibre of the tube, while the other remains at rest. Now, a fractured arm or a fractured thigh, put up with short splints, is placed under circumstances very similar, as far as it regards the rotatory motion of the rods mentioned in this experiment. The only difference consists in the slight resistance which the muscles give to the rolling of the fragments, in consequence of their being placed as a soft cushion between the splints and the bone.

Movement of the fractured ends.

It will be observed that the rods thus situated cannot be moved in the lateral or longitudinal direction, and very little in the angular; and, supposing them to be prevented from separating as they lie in a straight line, we can only produce a rotatory motion between them. Here we see that the rods can move in any considerable degree only in one direction; but the short splints surrounding a broken humerus not only do not prevent the rotatory motion to which the rods are subject, but they allow of displacement in three directions, lateral or transverse, longitudinal, and angular: therefore, we should infer that a broken humerus, put up with the common splints, is far less secure from the effects of passive motion accidentally given to the limb, than two straight rods whose approximated ends are placed within a portion of tube just large enough to admit them easily.

Sometimes i
all directions

Indeed, if we lay aside for a moment the slight effect which the muscles have in preventing displacement, we may consider a broken humerus, put up with common splints, to be situated like two straight rods, with two of their ends placed in contact within a portion of tube *much larger* than is sufficient to admit them; and which therefore allows of considerable derangement of the approximated ends, as well as rotatory motion between them.

Muscles oppo
derangement.

From what I have stated, it will be seen, that the muscles may oppose the derangement of the fragments of a fracture in three ways:—1st, By the attachment of their fibres round the fractured part. 2dly, By acting as a cushion between the splints and the bone. 3dly, Those muscles which arise above and are inserted below the fracture, tend, by their contraction, to keep the fractured surfaces from separating from each other, as long as the soft parts remain entire.

By their attac
ment.

It has been said that, while the muscular fibres which surround the fracture, preserve their attachment at the seat of injury, they tend to prevent displacement of the fractured ends; but suppose they are torn through, and the fracture is quite loose, will the support which they and the other soft parts give to the fracture, as a medium between the splints and the bone, be sufficient to secure the fragments from lateral derangement—especially if the fracture be oblique? Certainly not. What, then, will become of the third retentive power, derived from the contraction of the muscles, which arise above and are inserted below the fractured part? This power, as soon as transverse displacement is effected, instead of retaining the fractured ends in contact, causes them to ride; and if this is not prevented, deformity is the consequence.

Displacement and motion should be prevented.

But it is not the lateral displacement of the fractured ends, and the consequent displacement in the longitudinal direction only, that demand our attention: we must guard against angular displacement; by which I mean such a position of the extreme ends of the fractured bone as causes an angle to be formed at the seat of fracture: we must also guard against rotatory motion, which may be occasioned by an impetus given to the limb below the fractured part. Our business is to prevent every kind of derangement, whether lateral, longitudinal, or angular; and thereby to prevent deformity, and every kind of motion between the fractured surfaces, and thus to ensure reunion. Are these objects answered by the common short splints?

Difficulties experienced whe the short splints are use

In taking a general survey of what has been laid down by some authors who have written upon this subject, we are almost led to suppose that fractures of the humerus are unimportant accidents; that there is little to be done in the treatment; and that the surgeon may confidently expect a favourable result. But I would ask the ingenuous and experienced surgeon the result of his observations in the treatment of those cases which have come within his notice, and which have been treated by the common means. Has he not found it necessary to remove and repeatedly re-apply his splints during the cure? Has he not frequently, in doing this, produced motion between the fractured surfaces of the bone? Has he not often found, on visiting his patient, that his splints and bandages were loose and disarranged? Has he not often experienced great difficulty in keeping the fractured surfaces in apt and proper contact? Has he not occasionally found all his efforts ineffectual in preventing the occurrence of deformity? Has he not often noticed the cure to be long and tedious? Has he never met with cases in which all his endeavours to produce a union of the bones failed to be successful? Then, who is there acquainted with the treatment of fractures of the humerus, that would say that the common means are sufficient for all the purposes required? Is the prevention of deformity and non-union of no importance to our patients? Is the frequency of their occurrence no stigma on our profession? It might be said that the short splints have been used, and fractures of this bone have generally united. So a few years ago, even in this country, stumps were allowed to heal by the granulating process; many of them did well; but who will deny the great advantages arising from the present plans of treatment? I am aware that the best contrived means may be brought into discredit by the mal-practices of the careless and unskilful; but the treatment of fractures of the humerus with the common short splints cannot be supported upon principle; nor are they found sufficient to answer the indications which present themselves, even in the hands of the most skilful surgeons. Is it, then, enough because fractures of the simplest kind unite without deformity—is it enough because non-union is met with comparatively seldom—that we should still go on in the beaten path, and not try to avoid those modes of practice, the results of which disgrace us daily? I am disposed to believe, that every candid and scientific surgeon will agree with me in thinking, that here the treatment of fractures stood much in need of improvement. It is our business to discover wherein the means we employ in the treatment of any disease or accident fail to answer our intentions; and to suffer such as are discordant with the soundest principles to sink into oblivion, and to adopt in their stead such as are more safe and found to be more suitable.

Sec. 3.—*The Author's Treatment of Fractures of the Humerus.*

In the treatment of fractures of the humerus, as in the treatment of fractures of the thigh, our first object, as I have said, should be to fix the whole limb so far as to prevent any motion given to it from being felt in the situation of the fracture. In doing this, the hand should be guarded from accidental alteration in position, though, from the great mobility of the wrist, I do not think that *slight* and *gentle passive* motion would be at all likely to affect a fracture of the humerus, even if it were of the loosest kind. Flexion and extension of the fore-arm should be prevented. The elbow-joint should be perfectly fixed during the union of the bone.

It has been seen that the humerus is articulated to the scapula and bones of the fore-arm by the same kinds of joints that connect the femur to the pelvis and the tibia. Hence it appears, that the points of difference, in the treatment of the fractures of these two bones, should be drawn from the difference in their form, and from the difference in their situation with respect to the trunk. If the inferior extremity were attached to the scapula instead of to the pelvis, the treatment of a fractured thigh would differ very little from the treatment of a fractured humerus.

An apparatus, used to answer the indications above-mentioned, should be so contrived as to admit of being easily adjusted, and so as to maintain the situation with respect to the limb in which it is first applied, without producing more pain or inconvenience to the patient, than necessarily arises from the proper confinement of the parts.

Apparatus.

The apparatus to which I allude consists of three portions of beech (*Fig.* 1), two of which, *a, b,* are fixed together at a right angle; and the other, *c,* is straight, and of the length of

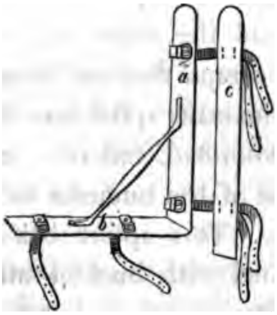


Fig. 1.

the humerus. The two portions connected are long enough to reach from the head of the humerus to the wrist. They are about two inches wide, and are excavated to the depth of about a quarter of an inch. That portion destined to lie upon the upper arm, *a,* has two straps attached to it transversely. Each of these straps is armed with a buckle, and is long enough to reach about three-fourths round the arm. One of the straps is fixed to the splint close to the angle formed by the junction of the two portions of beech; and the other a little below that part of the splint, which is made to lie by the side of the tendon of the pectoralis major; and in such a way that the buckles lie upon the splint. Another strap is fixed to that part of the splint intended to lie upon the fore-arm, near the angle formed by the junction of the two pieces of beech. Two studs are also placed upon this part of the splint, one in the middle and the other near its end, for the reception of straps destined to pass round the fore-arm. The other splint is of the same width as that last described, and of a length to reach from the head of the humerus to the lower end of the bone. This splint has two leathern straps furnished with buckles attached to it in a line transversely to the splint, and opposite to the straps fixed upon that part of the angular splint, which is destined to take the line of the humerus. Each of these straps should be sufficiently long to reach about three-fourths round the arm, and should be attached so as to be received by the buckles placed upon the angular splint. This splint is hollowed out about one-fourth of an inch at its upper part; and the depth of the excavation is gradually diminished to within two inches of the lower end, where the splint is left quite flat.

What I have above described constitutes the whole of the apparatus, which admits of being applied to adult arms of various lengths and sizes. But, besides this apparatus, it is proper, in order to add as much as possible to the comforts of the patient, and to secure the fracture from every kind of derangement and motion, to make use of three other splints, which may be made of split deal, in the common way. One of these should be long enough to reach from the arm-pit to the inner condyle, another from the point of the shoulder to the outer condyle, and the third from the elbow to the fingers.

Time for api cation.

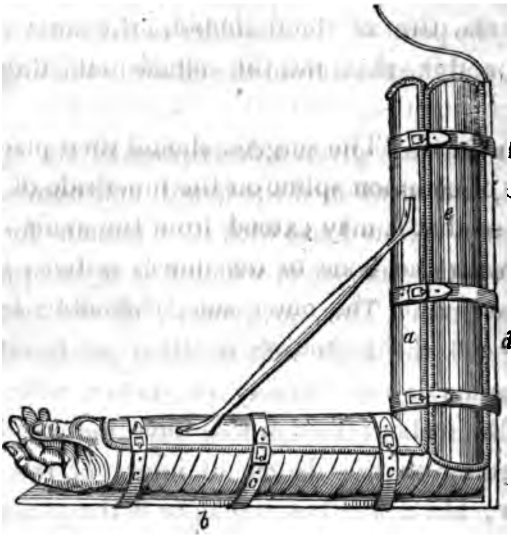
Having now given a description of the apparatus, and mentioned the length and number of common splints I use with it, it remains for me to show the manner in which it is to be applied to the limb. This, in general, should not be done till the high inflammation produced by the injury is considerably got under, which is usually in about three or four days, more or less, according to the degree of injury of the soft parts; but if the bones ride, or if the patient is restless, it is proper to apply it lightly as soon as possible after the accident.

Application

The surgeon should place the fore-arm so as to form a right angle with the humerus, and then support the integuments, by means of a spiral bandage, as high as the fractured part.

This part, being nicely adjusted, should be surrounded with strips of soap plaster, which should be drawn moderately tight. The surgeon, having pads properly made for each splint, should now commence the application of the apparatus, by placing the angular splint *(Fig. 2, a)*, upon the fore-arm, and then the longest deal splint, *b*, with a tape extending along its outer surface, in the ordinary way, should be placed beneath the fore-arm and hand. This splint and the angular splint should now be confined to the fore-arm by means of the proper straps, *c*, *c*, *c*, attached to the latter. This being done, the fore-arm should be given to an as-

Fig. 2.



sistant, who should keep it at a right angle with the humerus; and, if the fragments ride, he should be directed to draw down the fore-arm, while the surgeon placed the upper part of the angular splint in a line with the biceps muscle, and adjusts the fractured part. The straight splint, *d*, belonging to the apparatus being placed upon the back of the arm in a line with the humerus, the assistant should be directed to support this splint and the angular one in their proper situation, with the fractured bone between them. The surgeon should then place a piece of common splint on the inner side of the arm, so that it may extend from the axilla in a line with the bone to the inner condyle; and another, *e*, on the outer side, extending from the point of the shoulder to the outer condyle. The proper straps fixed to the apparatus should then be carried over the splints and buckled moderately tight. It is advisable to place an additional strap round the limb between these, as it assists in keeping the splints steadily and firmly together. The arm should now be placed in a sling extending from the elbow to the hand, and just short enough to steady the arm comfortably as it hangs by the side.

Mode of examination.

When the surgeon wishes to examine the

fracture, he may do it without disturbing the fragments in the least, by removing the splint placed along the outer side of the arm, while an assistant keeps the apparatus from shifting its situation.

By this plan of treatment the parts are kept quiet in their natural position; and thus deformity is prevented, and Nature is assisted in her efforts to consolidate the bone.

he apparatus eed not be connected with the capula.

Here it might be asked, why are the splints not confined to the scapula in the same way as the apparatus for the lower extremity is confined to the pelvis, in the treatment of fractures of the thigh? A little consideration, however, will make it appear, that though the humerus is articulated to the scapula by the same kind of joint as that which connects the thigh-bone to the pelvis, it is by no means necessary that the apparatus, described for fractures of the humerus, should be fixed to the scapula in the treatment of a fractured arm. The scapula is placed at a part of the body where it may be kept at rest without any inconvenience to the patient. The situation of the scapula, therefore, may be regarded as even more than sufficient to compensate for the loss of that support which the thigh receives in consequence of connecting the splints to the pelvis. Hence we may conclude, that any connexion of the splints to the scapula may be regarded as superfluous.

The following case, which is one of the first for which the apparatus was used, will illustrate its utility in the management of fractures of the humerus as they commonly occur.

April 15th, 1822.—John Alefounder, ætatis twenty-nine, was admitted into Guy's Hospital, under Sir Astley Cooper, for the cure of a fractured humerus. The fracture was occasioned by a fall from a height of twenty-five feet. It was situated a little below the insertion of the deltoid muscle, and extended through the bone in a direction slightly oblique. Case.

I saw him the fourth day after the accident, and, at this time, the lower fragment was drawn up considerably, indicating the fracture to be of the loose kind. The fragments being placed in proper apposition, the apparatus was applied, and the man was directed to carry the arm in a sling. Three weeks after the accident the apparatus was taken off, and the bone was found straight and firmly united.

Remarks. During the cure, I frequently moved the limb to show the pupils the power which the apparatus possesses in holding the upper portion, so as to make it move simultaneously with the lower, when the limb is passively rolled upon the scapula. Whenever the arm was moved, as here mentioned, the head of the humerus could be as distinctly felt rolling upon the scapula as if the bone were entire. The man never felt pain in the fracture from the rotatory motion given to the limb, nor was the process of union retarded. These circumstances are sufficient to show, that the fractured surfaces remain at rest when the limb is passively moved upon the scapula by an impetus given to it below the situation of the injury.

Now, if this be granted, it can be of little consequence whether the impetus given to the limb be intentional or accidental, supposing it is passive, and not violently applied; for, if the fractured surfaces are not disturbed in the one instance, it is not to be expected that they will be in the other; therefore we should infer, that the fracture is kept quiet at all times, when the whole limb is being gently and *passively* moved upon the scapula, provided that *no resistance* is made to the motions of the limb by the *vo-*

luntary action of its muscles, and that the fracture is not so high up as to prevent the splints from holding the upper fragment firmly. Hence we should conclude, that the apparatus, by keeping the fracture quiet, favours a speedy consolidation of the fragments: and, allowing this to be case, the patient may reasonably expect the powers of the limb will be restored to him proportionably early; and, as the pain occasioned by the derangement of the broken portions is avoided, as well as that which arises from repeated attempts to place them in their proper situation, the cure will be effected with much less inconvenience than he would experience under treatment by the common means. By this mode of treatment, too, the surgeon will be spared from that painful anxiety which arises from the knowledge of the insecurity of the fracture, and from the consideration that his reputation would suffer from what it might not have been in his power to prevent—the occurrence of deformity or non-union of the bone.

The following cases were accompanied with peculiar circumstances. I shall relate them here for the purpose of further illustration.

John Barret, ætatis sixty-three, was admitted Case.

into St. Thomas's Hospital, November 11th, 1822. A few hours before his admission, he fell down four steps, and pitched upon his elbow in the stone yard. The force of the fall produced a fracture of the humerus, which commenced a little above the condyles, and extended very obliquely through the bone in a direction upward and outward. I saw him the fourth day after the accident. He was then in bed, with his limb lying upon a pillow. The lower fragment was drawn up from two to three inches. The limb was much swollen, and the man was suffering greatly. Short splints had been applied, but were found ineffectual in supporting the parts in their proper situation.

This man was under the care of Mr. Travers, who now politely offered me the treatment of the case. Assisted by his apprentice Mr. Dunkin, I applied the apparatus lightly, but, at the same time, sufficiently close to prevent the fractured ends from riding. Two days after the application of the apparatus, the straps were tightened, and the man was desired to leave his bed, and carry the arm in a sling. February 28th, 1823, the apparatus was taken off, and the bone was firmly united.

Remarks. In this case, it will be observed that nearly three months had elapsed before the consolidation of the bone was completed. I have selected it purposely to illustrate the effect of motion between the fractured surfaces, in retarding the progress of union, and to show the necessity of guarding against the voluntary action of the muscles.

This man was in his dotage, and could not be prevailed upon to keep the limb quiet. He frequently raised the arm by the action of the deltoid muscle, and thus caused the fractured surfaces to rub upon each other. He was frequently informed, that his omitting to comply with directions, in this particular, would retard his cure; but it was found that he either did not comprehend or recollect the caution. The straps were, therefore, drawn closer, even to a degree which was painful to him; but crepitus was still produced by the voluntary action of the muscles, though none was felt when the limb was passively rolled upon the scapula. I was led to believe, that union would not take place as long as motion was continued in the fracture; and, as reasoning was lost upon him, I bound the arm to the side, so as to deprive him of the possibility of raising it by the voluntary action of the muscles, and, at the same time, shortened the sling, so as to keep the fractured parts closely applied to each other. After persevering in this plan for three weeks, I was happy to find that it had perfectly succeeded. The extreme points of the fractured ends could be felt when the fracture was united, and it was ascertained that the obliquity was above one inch and three-quarters.

Case. Sarah Cooke, ætatis sixty-two, much troubled with rheumatic gout, was admitted into St. Thomas's Hospital, February 11th, 1823, under the care of Mr. Green. She had a transverse fracture of the humerus about mid-way between the insertion of the deltoid and the head of the bone, and a transeverse fracture of the olecranon. Neither of the fractures was attended with any considerable laceration of the soft parts. The fracture of the humerus was easily discovered by rotating the lower portion, while the upper was fixed; and the fracture of the olecranon was equally distinct; but as the periosteum was not torn, the fractured surfaces were not separated from each other. Both the fractures were attended with great tumefaction in the affected parts, which was removed by rest in the horizontal position, and cooling lotions to the limb.

February 21st, I saw her, with Mr. Green, who kindly offered me the superintendence of the case. The apparatus was now applied, by his dresser Mr. Thomson, and she was directed to leave her bed, and carry her arm in a sling. March 22d, the apparatus was taken off, and the humerus was found united, and also the olecranon, by the interposition of bony matter. The callus, which joined the olecranon, could be distinctly felt through the integuments.

Remarks.

This case is interesting, inasmuch as it shows that her habitual disease, which had greatly enlarged the joints of her fingers, &c. and limited their motion, did not interfere with the process of union in the fracture; and that the apparatus is applicable in cases which are complicated with fracture of the olecranon, when the periosteum remains untorn.

CHAP. X.

FRACTURES OF THE FORE-ARM.

SEC. 1.—*Fractures of the Olecranon—Causes, Nature, and Symptoms.*

Anatomy. THE two bones of the fore-arm are articulated to the humerus and the carpus, by ligaments. The ulna is articulated to the inner part of the trochlea of the os humeri, and has a hinge-like motion upon this bone. The olecranon, placed at the upper end of this bone, prevents it from forming an angle with the humerus backwards, but commonly allows the ulna to be extended upon the humerus, so as to form nearly a straight line with it. The radius lies at the outer side of the fore-arm. The head of this bone is articulated to the outer part of the articular surface of the humerus, where it moves freely upon the outer condyle. This bone is also connected to the ulna by means of the ligamentum annulare, the interosseous ligament, and the sacciform ligament. The bone of the radius moves freely upon the head of the ulna in the acts of pronation and supination.

Relative pos tion.

The reader should bear in mind the particular manner in which these bones are placed with respect to one another. They are in contact near their ends, but, by their particular formation, they are kept asunder at every other part.

Fractured si ly or togeth

These bones may be broken singly or together, and the fracture may be merely a division of the bone or bones, or it may be attended with more or less injury of the softer textures. Sometimes the accompanying laceration is great, allowing the fractured ends to become much displaced, and is not unfrequently so extensive as to make the fracture compound.

Of the olec non.

As the fractures of the olecranon require a different treatment from that which I shall consider it expedient to advise in the management of the other fractures of these bones, it will be better to speak of these under a distinct head.

Cause.

The olecranon is frequently broken off from the body of the ulna, by falls upon the elbow, and sometimes by the violent action of the extensor muscle.

Nature. The fracture is commonly simple, and for the most part transverse, or nearly so; now and then, however, this portion of the bone is broken into several pieces; occasionally the fracture is compound. Simple fractures of this bone are not dangerous to life, though they must be regarded as serious accidents, in consequence of the inflammation which takes place in the joint, and the retraction of the upper portion, which it has been found difficult to keep properly in its place.

Symptoms. There is commonly considerable laceration accompanying a fracture of the ulna at this part. When this is the case, the olecranon is drawn away from the shaft of the bone, by the action of the triceps muscle. The fractured surfaces are separated by the contraction of this muscle, sometimes half an inch, sometimes an inch, and occasionally two inches, or even more. When the olecranon is broken into several parts, the different pieces are sometimes separated in various ways, according to the degree of injury which the close coverings have sustained. The fracture sometimes takes place here, without giving rise to any noticeable space between the fractured surfaces. When this is the case, the existence of the fracture may be ascertained by its readily moving under the influence of the surgeon's finger and thumb.

Fractures of the elbow-bone, when accompanied with laceration of the soft parts, are very easily discovered, and the experienced surgeon has no difficulty in forming a correct diagnosis, even where the fractured surfaces continue in close apposition. The fore-arm is commonly more or less bent in all cases, and the patient has little or no power to extend it, while the fracture is recent; if he attempts to do so, it gives him considerable pain. A soft tumour appears behind the joint soon after the accident, and when there is laceration sufficient to allow the olecranon to be retracted about half an inch, the surgeon finds that his finger readily passes between the fractured surfaces towards the interior of the joint. If the fractured surfaces be not separated sufficiently for this purpose, their rough edges may usually be felt through the integuments.

Rarely unite by bone.

These fractures have seldom been found to unite by the intervention of callus. This must be attributed more to the insufficiency of the usual modes of treatment, than to any thing in the physical condition of the fractured parts. This I think will appear, when it is considered that, if the vessels which run from the shaft of the bone to the olecranon be cut off in consequence of the fracture, there is still a supply of nourishment to the upper portion, from the vessels of the parts which surround it. We must not, therefore, suppose that an insufficiency of blood to support an ossific action is the cause of non-union in this part, but regard it as the result mainly of the tonic contraction of the triceps muscle, which the mechanical means hitherto employed have not been sufficient to overcome, so as to maintain the fractured surfaces in a state of permanent apposition and rest. In order to make this matter more evident, let us point out the indications which we observe in these cases, and investigate the different plans by which surgeons have attempted to answer them.

SEC. 2.—*The usual Modes of Treating Fractures of the Olecranon.*

Indications.

In order to bring the fractured surfaces into apposition, and keep them closely applied to each other, it is necessary, 1st. To maintain the fore-arm steadily extended upon the humerus;

and 2ndly, To resist the action of the triceps extensor muscle.

Treatment.

These indications we are directed to answer in various ways. The common plan of treatment is to apply a roller round the fore-arm, beginning at the wrist and gradually carrying the bandage up the arm in a spiral direction, till it is brought to the joint round which it is placed, in the form of the figure 8. A splint is then applied to the front of the arm, long enough to extend some way above and below the joint, so as to keep the arm extended.

Remark.

This mode of treatment supports the parts very imperfectly. The bandage gets loose, and the triceps is soon at liberty to retract the upper portion of the bone, as far as the laceration of the surrounding textures will allow.

Sir A. Cooper treatment.

Sir Astley Cooper recommends the following plan, *(Fig.* 1*)*. "If," says Sir A., " the swelling

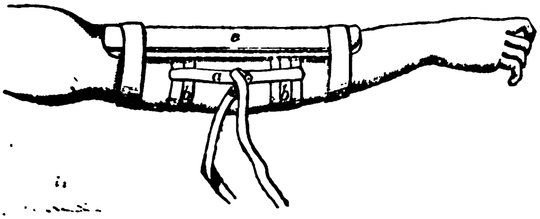


Fig. 1.

and inflammation do not prevent it, the surgeon is to place the arm in the straight-position, and to press down the upper portion of the fractured olecranon, until he brings it in contact with the ulna; a piece of linen, *a*, is then laid longitudinally on each side of the joint; a wetted roller, *b*, is applied above the elbow, and another below it; the extremities of the linen, *a*, are then to be doubled down over the rollers, and tightly tied, so as to approximate them; thus the bones are brought and held together; a splint, *c*, well padded, is to be applied upon the fore-part of the arm, to preserve it in a straight position, and is to be confined to it by a circular bandage; the whole is to be frequently wetted with spirits of wine and water."

Objections.

The mode of treatment here advised by Sir Astley, is not without objections. The circular bandages have not sufficient hold upon the olecranon, to keep it in its proper situation, unless they are drawn so tight as to impede in a very great degree the circulation of the limb; and even then, I very much doubt whether the upper portion can be kept in contact with the other. My readers will perceive by the drawing copied from Sir Astley Cooper's work on Dislocations, that a circular bandage applied as is here represented, can have but little or no effect. The drawing merely illustrates the situation of the circular and lateral portions of bandage, without representing any of those evils which, when they are applied so as to act upon the olecranon, they commonly produce upon the limb. Pain and tumefaction, to no inconsiderable degree, are the almost necessary consequences of this mode of treatment, when followed up so as to produce any good effect upon the retracted portion of the bone. If the circulars be loosely applied, it must be evident that no good can be obtained by them; for, when the surgeon draws the lateral portions of linen with a view to keep down the olecranon, he will bring the two circulars into contact, without advantageously altering the situation of the olecranon. Again, what muscles do we want to act upon in the treatment of these cases? It is very plain that the triceps extensor cubiti is the only muscle that tends to produce retraction; this, therefore, is the only one whose action could be beneficially resisted by the portions of linen applied as Sir Astley recommends; but according to this plan, the other muscles surrounding the lower part of the humerus, and destined to act upon the forearm are equally compressed or nearly so, by

Sir Astley's upper circular. This, of course, materially increases the patient's uneasiness, without being followed by any adequate advantage. The contraction of the flexors of the fore-arm must be overcome, and the limb maintained in the straight position; but these indications are answered by the splint applied upon the front of the arm, which is in no way assisted in its operation by the action of the circulars and lateral portions of linen.

SEC. 3.—*The Author's Treatment of Fractures of the Olecranon.*

Author's plan.

Apparatus.

The means which I have recourse to in the treatment of fractures of the olecranon, consist of the little apparatus here depicted; a long straight splint well padded, and a roller. The pads of the apparatus, *a*, *a*, *(Fig. 1)*, are made

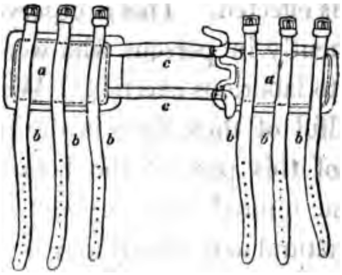


Fig. 1.

of two portions of soft hide-leather, padded with kersey, which is covered with lamb-skin. Straps are attached to the pads in the situations represented in the drawing. The circular straps, *b*, are made of leather, but those, *c*, *c*, fixed to the end of the upper pad are composed of strong web, for the purpose of more accurate adjustment when the apparatus is applied. When the active inflammation is sufficiently got under, which may be in the course of three or four days, more or less, according to the severity of the accident, these powers should be employed.

Before describing the mode of applying these means, it may be proper to remark that some persons are incapable of extending the fore-arm, so as to form a straight line with the upper arm. The reason of this is commonly, I believe, some enlargement of the olecranon, which causes it to come in contact with the posterior part of the humerus, before complete extension is effected. This is observed to occur most frequently in persons who were much accustomed to laborious exertion. We should not be unmindful of these facts in the treatment of fractures of this part of the bone; for if we extend the injured arm beyond that degree which is natural to it, which may be easily done when the olecranon is broken, we shall separate the anterior edges of the fractured surfaces, more or less, in proportion as we force the arm backward beyond its natural limit of extension; and thus, by preventing a close adaptation of the fractured part, we shall diminish the chances of producing union by the intervention of callus. In the management of these cases, the limb should not be extended beyond that degree which is natural to it; and this is easily ascertained by noticing the greatest degree of extension which the sound limb admits of; and by shaping a pad to the front of the sound limb in the straight position, in such a manner, that when the splint and pad are placed upon it in this position, the splint may bear equally throughout its length. This splint and pad will act in the same manner, when applied to the front of the injured limb, and, when properly adjusted, will maintain the injured limb at that degree of flexion which is natural to it when it is most extended.

Application.

The inflammation having been sufficiently reduced, the surgeon should proceed to fix the fractured parts. It is proper in the first place to apply a linen or calico roller, *a*, *(Fig. 2)* to the arm in a spiral direction commencing from

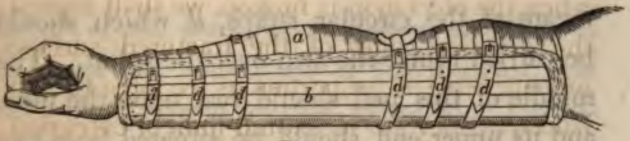


Fig. 2.

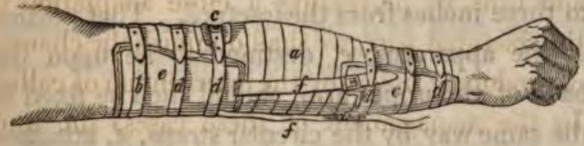


Fig. 3.

the wrist, and carrying it up to a little below the fracture, taking care to draw down the integuments of the fore-arm, and to fix them under the bandage, so that they may not get into folds over the fractured part. While the surgeon is applying the bandage, the limb should be held in the straight position; and when he has brought it up to within a short distance of the fracture, he should desire an assistant to press down the upper portion of the olecranon, and at the same time avoid getting the skin into folds over the site of the fracture, and when this is accomplished, the surgeon should pass the roller three or four times round the arm, at the elbow joint, in the form of the figure 8, and fix it. The assistant continuing to support the fractured surfaces in contact, the surgeon now applies the padded splint, *b,* to the front of the arm, and fixes that portion of the apparatus, *c,* *(Fig. 3)* destined to lie upon the fore-arm by means of the circular straps, *d*, which should be carried round the arm over the splint. The middle of this pad should rest upon the ulna, and its upper end should be situated from two to three inches from the fracture. That portion of the apparatus, *e*, destined to lie upon the back of the upper arm, should then be fixed in the same way by the circular straps, *d*, attached to it. This pad should be placed so that the middle of its lower end may lie immediately above the point of the olecranon. The assistant should place his hand upon this pad, and gently force it downward and against the back of the arm, so as to prevent the olecranon from shifting from its natural situation, while the surgeon fixes the upper and lower pads together by means of the corresponding straps and buckles, *f*, *f*, with a view to maintain a permanent and effectual resistance to the action of the triceps, and thereby prevent the retraction of the olecranon.

Rationale of the plan.

I employ the linen roller in these cases in order to give gentle support to the integuments of the fore-arm, so that the pressure on one part may not create uneasiness in another. The splints and the apparatus have a connected action upon the triceps extensor cubiti and flexors of the fore-arm, the effect of which is to resist the contraction of the muscles, and keep the fore-arm steadily extended. The indications which I have noticed may be more effectually answered by this plan than by any other with which I am acquainted.

But it might be said, how is the action of the triceps resisted? My readers will perceive that advantage is here taken of the configuration of the fore-arm, which is somewhat conical, to form a point of resistance, which is accomplished by fixing the lower part of the apparatus upon the fore-arm, as represented in the drawing; and the upper pad, being buckled closely to the arm, compresses the lower part of the triceps over which it lies, against the humerus, and thus, in some measure, assists in preventing the injurious contraction of the muscle. The lower end of this pad is formed so as to act upon the olecranon, which is retained in its proper situation principally by the resistance which the lower pad affords to the action of the triceps, when the two pads are connected together by means of the corresponding straps and buckles attached to their opposing ends. In this way the resistance, which in the natural state is given to the action of the triceps by the olecranon is transferred to the lower part of the fore-arm. The resistance which is given to the action of the triceps by this plan cannot be expected to be so complete as that which it receives from the uninjured bone; but the careful surgeon will rarely find any difficulty in keeping the fractured surfaces so closely applied to each other as to bring about a very short ligamentous union, if not a union by the effusion of callus.

I do not think that union by bone will generally be produced, because of the difficulty which must be experienced in resisting the action of the triceps muscle so effectually as to keep the fractured surfaces always in close apposition and at rest. This, however, is a matter of little consequence to the patient, as a short ligamentous union is as useful as one effected by bone.

The treatment should be continued at least a month, and in bad cases a longer period will be necessary; for if the union should be by short ligament, the ligament will stretch very much if the apparatus be removed before it has become firm, and consequently the power of the arm may be greatly diminished; and if the surgeon hopes to produce bony consolidation, a month or more will be required for the completion of the process.

As soon as the apparatus might be with propriety discontinued, our business is to restore the motion of the joint, which should be done with great caution. The apparatus which I employ in the case of stiff elbow-joints, produced by other causes, will be found the most effectual in getting over the stiffness of the joint, produced by the consequences of a fracture of the olecranon. In whatever way the surgeon attempts to restore the natural movements of the joint, he should bear in mind the propriety of using only gentle means, and that violent force should never be had recourse to.

SEC. 4.—*Fractures of the Coronoid Process of the Ulna.*

Fracture of the coronoid process is a very rare accident, and one which has not come under my observation in the recent state. Sir Astley Cooper mentions the following circumstances, which occurred in a case that he saw several months after the accident. A gentleman fell upon his hand whilst in the act of running, and on rising, he found himself incapable of bending his elbow, nor could he entirely straighten it. His medical attendant found, upon examining the limb, that the ulna projected considerably backward, but, as soon as he bent the arm, the bones were brought into their natural position. Sir Astley states, that the limb presented the same appearances when he first saw the patient, *viz.*, "the ulna projected backwards, whilst the arm was extended, but it was without much difficulty drawn forwards and bent, and the deformity was then removed."

The reason of these alterations in the relative position of the parts, in the extended and flexed state, will immediately appear to those who are acquainted with the anatomy of the joint. The coronoid process keeps the ulna in its proper situation, with respect to the humerus when the limb is extended, provided it be entire; but if this process be broken off, the resistance which it offers to the action of the triceps is removed, the base of the ulna will, therefore, be drawn backwards more or less behind the humerus;

but when the fore-arm is bent upon the humerus, the radius, acting as a lever, causes the ulna to advance into its natural situation.

Treatment.

The evident indication in the treatment, is to keep the arm steadily bent to a right angle, as this position diminishes the influence of the brachialis internus, upon the fractured coronoid process. This might be easily done by means of a trough, made to fit the arm at a right angle, and long enough to extend from near the arm-pit to the hand. The trough may be secured to the limb with a bandage or with tapes, and the arm may be supported in a sling.

Prognosis.

The prognosis in this accident is unfavourable, as this process of bone has not been found united by the interposition of bony matter. Ligament is the medium by which union is effected. It will be well, however, I should think, to confine the arm for a month or five weeks, in order to give the part a chance of uniting by bone, and if it should unite by ligament only, this period will not be too long to allow the ligament to get strong and more capable of resisting, than it otherwise would, the force that tends to displace the base of the ulna backward. I do not anticipate that this fracture will ever be made to unite by bone, for the action of the brachialis internus will constantly tend to keep the fractured surfaces asunder, but more especially so if the fracture be attended with much laceration; and we have no means by which we can resist the action of this muscle and keep the fractured surfaces closely applied to each other.

Sec. 5.—*Fractures of the Body of the Ulna, and Fractures of the Radius singly and together—Causes, Nature, and Symptoms.*

Cause.

Fractures may occur at any part of the body of the ulna. They are found to arise principally from blows upon the part.

Nature.

The fracture may be more or less complicated, and attended with little or much laceration of the parts surrounding the seat of injury in the bone.

Symptoms.

These fractures are usually easily discovered, by taking the portions of the bone between the fingers and moving the hands in opposite directions. When a fracture exists, this mode of examination will produce preternatural motion and crepitus. Sometimes the fractured ends are displaced, and this is generally the case if the textures immediately surrounding the bone be much torn. In these cases, an irregularity may be discovered, by passing the finger along the line of the inner edge of the bone, where it is nearest to the surface.

Remark.

The general treatment of fractures of the body of the ulna, does not differ from that of fractures of the body of the radius. I shall, therefore, speak first of fractures of the radius, and then give the treatment of those which occur in the body of this bone, and also that which it will be proper to adopt in the management of fractures of the body of the ulna in connexion.

Fractures of the radius.—Neck.

Fractures of the neck of the radius are of very rare occurrence. I do not remember ever having seen an instance of it, and perhaps some of those cases which have been looked upon as fractures of the neck of the radius, were in reality fractures of the external condyle of the humerus. It has been doubted by high authority, whether such fractures ever occur at the neck of the bone. I see no reason, however, sufficient to induce me to believe that fractures may not be produced here, under certain circumstances, as well as in any other part. We will suppose, for instance, that a man receives a smart blow upon this part, operating in a certain direction. Can any reason be assigned why the bone should not give way at the neck as easily as elsewhere? I see none whatever. This is, in fact, the smallest part of the bone, and, upon a superficial consideration, one would apprehend, that it would here be found the most subject to fracture.

Cause of their infrequency.

The cause of this accident occuring so seldom is, I conceive, to be explained, in a great measure, by referring to the particular form of the base of the humerus, and the situation of the head of the radius with respect to it. We observe that the condyles of the humerus project laterally, in such a manner as to shield effectually the head and neck from many injuries in which they would otherwise participate: such as a crush or blow, which might act in part upon the radius, but principally upon the humerus, producing, perhaps, a fracture of the latter bone, without injuring the former. If the force acts upon the inner side of the limb opposite the neck of the radius, the ulna receives it, and the radius may remain uninjured. When a force acts behind the arm so as to exert its influence principally upon the end of the radius, the head of the bone is driven off the condyle, so as to produce a dislocation forward, more readily than the neck becomes fractured. If the force be applied in front, the bone is more easily dislocated backward than broken. The ulna and radius become dislocated off the humerus, forward or backward, according as the force may happen to impel them, without the radius receiving any injury, in consequence of the facility with which it is driven off the condyle of the humerus.

From what I have said, the reader may perceive that there is so much protection given to the radius at this part, by its relative situation with respect to the ulna and humerus, that it is not to be wondered at that fractures of the neck of the radius so seldom occur.

Symptoms.

The existence of a fracture at this part would be shown, by fixing the head of the radius against the ulna, and at the same time rotating the body, which would give rise to preternatural motion and crepitus at the neck, while the head of the bone remains motionless under the thumb.

Treatment.

It is probable that the bent position would be found the most preferable in the management of a fracture of this kind. The bent splint, described in the last chapter of this work, may be found the best for supporting the limb in that degree of flexion which, it would seem, is the most desirable for the surgeon to maintain.

Fractures below the tubercle.

Fractures in every part of the radius below the tubercle are very common; it is thought more so than fractures of the ulna. When we consider the natural connexions of the base of the radius with the bones of the wrist, that it is the only bone of the fore-arm upon which the force of falls upon the hand is sustained, and the great frequency of falls upon the hand, we might, *à priori*, expect to meet with a greater number of fractures in this bone than in the ulna: lying too on the outer side, and when the hand is semi-prone in a great measure anterior to the ulna, it is more exposed to blows and other injuries than the ulna.

Causes.

Fractures of this bone may be more or less complicated, like those which occur in the ulna; and when the bone is healthy, they are always produced by external force, variously applied.

Symptoms.

The immediate symptoms of fracture of the radius, are usually an inability to render the hand supine; generally more or less deformity in the appearance of the bone; preternatural motion and crepitus, when the fracture is complete. The crepitus may be felt by simultaneously fixing the part of the bone above the fracture, and rotating the hand so as to roll the carpal portion, or by moving the upper and lower portions in opposite directions so as to make the two fractured surfaces rub upon each other.

Fracture of both bones.

Both of the bones of the fore-arm are frequently broken at the same time. These accidents being more severe, require more care in the management than fractures of either the ulna or radius alone.

Symptoms.

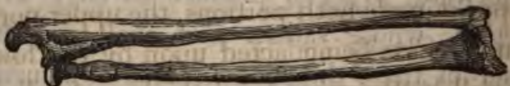
When both bones are divided, the lower portion of the fore-arm may be moved backward or forward, so as to produce an angle at the fracture, whose salient part shall project in either of these directions. This circumstance alone is sufficiently diagnostic of an injury of this kind, but deformity, preternatural motion, and crepitus, will also be observed.

Deformity after fractures of these bones.

Those gentlemen who have had opportunities of seeing much of fractures of the fore-arm, will doubtless have observed, that they frequently unite with considerable deformity. This is particularly the case if the periosteum be torn through, and the fracture be situated at the lower part of the fore-arm, whether one or both bones be broken. The deformity which takes place, is attributed to the action of the pronator radii teres, and the pronator quadratus, and it will not be questioned, that these muscles have a very powerful influence in producing it. It will be found, however, that the action of these muscles is not the only cause; we must add to this the mode of treatment, which is commonly followed during the process of consolidation.

Let the surgeon bear in mind the natural situation and position of the ulna and radius, with respect to one another (*Fig.* 1); let him remember that they are in contact only at their ends, and that there is a considerable space between them at every other part, especially near the carpal extremities.

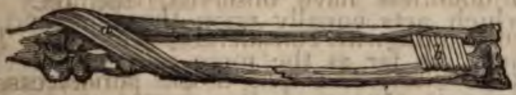
Fig. 1.



Muscles.

The accompanying sketch (*Fig.* 2), will call to the recollection of the surgeon, the natural situation and direction of the two muscles I have mentioned, and from the direction of their fibres, he will readily see what effect they are likely to have upon the bones when broken. When the radius is broken, the pronator radii teres, *a*, will tend to approximate one fragment at least to the ulna. If the fracture happens to be above the insertion of the muscle, and to extend downward and outward, it will approximate the lower fragment; and if the fracture be below its insertion, and extending downward and inward, it will approximate the upper fragment. If the fracture be situated above the insertion of the muscle, and extend through the bone downward and inward, its action will tend to approximate both portions, the upper portion in such a case being acted upon by the lower; this will be the case also if the bone be divided in a direction downward and outward, below the insertion of the muscle, the lower portion being acted upon by the fractured end of the upper.

Fig. 2.



The muscle, however, which has the greatest effect in producing deformity, is the quadratus, *b*, which acts equally upon the ulna and the radius. As far as the mere influence of these muscles is concerned, the degree of displacement of the fractured ends will always depend upon the situation and direction of the fracture, and the degree of laceration which accompanies it. Should the fracture extend through the ulna downward and outward, or through the radius downward and inward, the quadratus will cause the upper fractured end to be approximated to the opposite bone as much as the lower; but should the fracture extend through the ulna downward and inward, or through the radius downward and outward, the lower portion of the bone will be principally acted upon by this muscle. From these examples, the reader might easily infer what would be the effect of the contraction of this muscle, in other varieties of fracture of one or of both bones.

It should be borne in mind then, that in whatever part of the bodies of these bones the fracture may occur, the quadratus muscle tends to produce deformity, and the action of this muscle is more or less assisted in all cases of fracture of the body of the radius extending downward and outward, by the pronator radii teres.

But how do surgeons attempt to resist this evil, to prevent the injurious consequences arising from the contraction of these muscles, which we have so frequently to notice, the approximation of the bones and permanent deformity of the limb? What is the practice of the present day—the practice taught in the schools, and acted upon by most of those who have the management of these injuries?

Sec. 6.—*The usual Mode of Treating Fractures of the Bodies of the Ulna and Radius.*

Indications.

The indications which should be answered in the treatment of fractures of the bodies of the ulna and radius are, 1st. To keep the bones from being brought by the action of the muscles into nearer approximation than is natural to them: 2ndly. To keep the bones straight; and, 3dly. To avoid all lateral pressure which can in any way tend to cause the sides of the ulna and radius to approach each other.

Common treatment.

Now let us see how far the common plan of treatment tends to answer these indications. Surgeons are directed to apply soap-plaster, and also a roller round the fore-arm, extending from the wrist to the elbow in a spiral direction. I do not perceive that any advantage is likely to be gained by the application of either the plaster or the roller in the management of fractures of the fore-arm; but I am well aware that they may be, and very frequently are applied so as to produce irreparable mischief. If we apply a roller round the fore-arm while the bones are entire, we give a degree of support to the soft parts, which in many affections is found beneficial; but if we apply it where one or both bones are broken, the same benefit cannot be obtained without great danger of producing deformity; for the constant tendency of the bandage, if applied so as to give any support, is to force the sides of the bones into contact, (*Fig.* 3 *and Fig.* 4) which it would be likely to effect, even if they were not at all influenced by the contraction of the muscles.

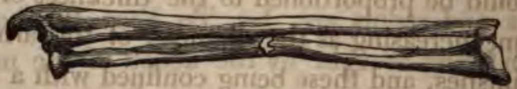


Fig. 3.

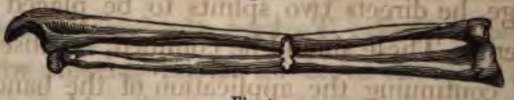


Fig. 4.

Well, having applied the plaster and spiral bandage, we are directed in the next place to apply two splints of split deal, long enough to extend from the elbow to the fingers. One of these is to be padded and placed along the front of the arm, and the other along the back. These splints yield to the natural figure of the arm, and are confined in their situation by another roller which extends from the wrist to the elbow, or by tapes, which have the same effect.

Splints

Some surgeons recommend short compresses to be placed between the bones just where the fracture is situated; but compresses can be of little use where their operation is assisted by splints so little to be depended upon as those in common use. When both bones are fractured, Boyer recommends two graduated compresses to be applied, one on the back, and the other on the front of the arm, the depth of which should be proportioned to the thickness of the arm, increasing as the diameter of the arm diminishes, and these being confined with a bandage, he directs two splints to be placed over them. These should be confined, he observes, by continuing the application of the bandage, used to support the compresses.

end to produce deformity.

It seems to me it must be evident, that the means which I have mentioned, are not calculated to keep the bones in their natural relative position; but to bring them into contact in situations where they are naturally apart, and thus, in many instances, to occasion the deformity which it is our business to prevent.

Sec. 7.—*The Author's Mode of Treating Fractures of the Fore-Arm.*

onvex splints.

After some reflection upon the subject of fractures of the fore-arm, it appeared to me that the indications above pointed out might be answered by means which can be made to bear steadily between the bones without acting at all on the inner or outer side of the arm so as to produce any injurious consequence. Under this impression, I contrived a pair of double convex splints, *(Fig. 5)* one of which, *a*, is

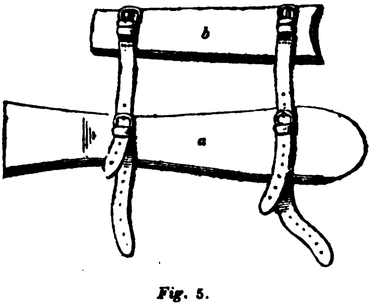


Fig. 5.

intended to lie upon the back of the arm, and to extend from the elbow to the tops of the fingers; and the other, *b*, upon the front, and to extend from the bend of the arm to the bones of the wrist. When these splints are applied, they press the long muscles between the bones, and support the bones, so as to prevent their approximation. The short splint should extend to the carpal bones and no further. If this be not attended to, the splint gives pain by pressing upon the soft parts over these projecting bones, and in consequence of the resistance which it would receive from them, it would not act so as to keep up a proper support between the ulna and radius, which is the great object which these splints are intended to answer. The young surgeon need not be afraid of pressing the bones too far asunder: all lateral derangement of this kind is effectually prevented by the attachments of the interosseous ligament. The convex splints should be a little wider than the fore-arm, and should be applied in the following manner.

Application.

As long as the active inflammation is considerable, the arm should be kept upon a splint, padded and raised upon a pillow; but when it is sufficiently subdued, which usually happens in three or four days, according to the severity of the injury, the surgeon should provide a split deal splint, long enough to reach from the elbow to the tips of the fingers, *b*, (*Fig.* 2) and from an inch and a half to two inches wide for an adult, and have pads made for it, and for the two convex splints. The pads should be composed of three or four layers of flannel, covered with soft linen or calico. He should then desire an assistant to raise the arm, and bring it into a position nearly supine; and then if necessary, make gentle extension, holding the wrist in one hand, and the upper arm in the other, while the surgeon adjusts the fractured ends, and applies the apparatus, (*See Fig.* 2 *and* 3). The long convex splint (*Fig.* 3,) *a*,

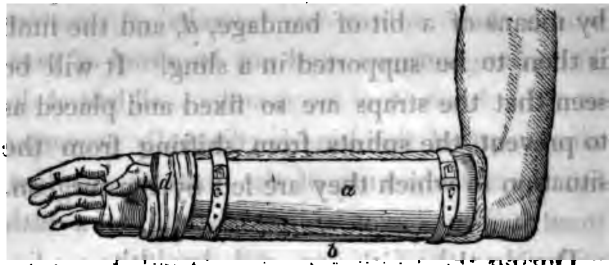


Fig. 2.

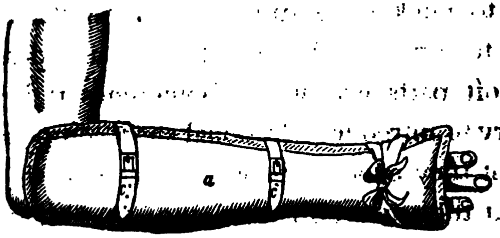


Fig. 3.

should be applied to the back of the fore-arm, so that its more convex part shall be opposite the space between the bones. The short convex splint *(Fig. 2)* *a*, is placed so that the most prominent part of its convexity shall lie opposite the space between the ulna and radius. The assistant should then hold these two splints with the fore-arm lying between them, while the surgeon places the split-deal splint, *b*, along the line of the ulna. The straps, *c*, which are fixed upon the convex splints are then to be buckled round the limb, so as to secure the splints, and make them press with gentle firmness. This being done, the hand is to be secured to the broad flat part of the back splint by means of a bit of bandage, *d*, and the limb is then to be supported in a sling. It will be seen that the straps are so fixed and placed as to prevent the splints from shifting from the situation in which they are left by the surgeon.

Remarks.

During the uniting process, it will be necessary to buckle the straps a little tighter from time to time, as the tumefaction subsides, or the soft parts give way. Sometimes it is necessary to introduce additional short compresses, so that they may lie between the ulna and radius at the seat of fracture, and assist the convex splints in keeping the fractured bones in a proper line, which they do, by causing the splints to bear more firmly here than at any other part. I may remark, also, that, the sling should support the limb equally from the elbow to the wrist, and should be left long enough to allow the fore-arm to hang, so as to form a right-angle with the upper arm. If these little points be not attended to, the surgeon ought not to expect a favourable result. If the sling be too short, and the weight of the fore-arm be thrown upon the sling at the wrist only, there is danger, when both bones are broken, that the fractured ends will unite at an angle projecting inward, (*Fig.* 6). The reason of this will immediately appear; the split deal splint would not be pressed upon equally by the sling, and consequently the arm could not be equally supported. The humeral portions of the bones drop a little, while the carpal portions are supported by the sling, and hence arises that variety of deformity which I have mentioned, and which is always, as far as I have observed, referable to the improper management of the surgeon.

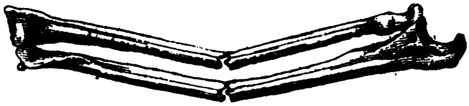


Fig. 6.

I have seen the convex splints employed without the split deal splints; but this cannot generally answer when the ulna is broken, and is far less comfortable to the patient when it is entire, and the radius only fractured. The patient seldom wears the sling so that it shall support the arm equally at every part; and, if the sling press more in one part than in another, angular deformity is almost sure to be produced: for instance, if it press more at the elbow and hand than in the middle of the fore-arm. When both bones are broken the middle of the arm will sink, and that variety of deformity, which I have just mentioned, will probably occur. If, on the contrary, the middle of the arm bears more upon the sling than the elbow and hand, the ulna will be pressed towards the radius, and angular deformity will be produced in the opposite direction, (*Fig.* 7); and this the convex splints have no power to prevent; because they are pushed out of their proper situation, by the action of the sling. From what I have said, I think the reader must be sensible, that the split deal splint ought not

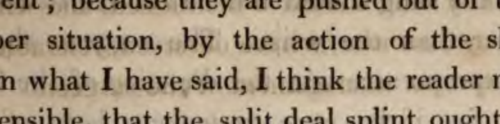


Fig. 7.

to be omitted in any instance, even when the ulna is not fractured; for in such cases, as in all others, it adds to the comforts of the patient, by forming an easy bed for the limb to rest on, and at the same time prevents the sling from operating so as to force the convex splints away from their proper bearing—an effect which it always has more or less, when the split deal splint is not employed. He will also see, that the regulation of the sling is a part of the surgeon's duty, which he ought never to neglect.

Fractures of the base of the radius.

I would observe, with respect to fractures of the base of the radius dividing the bone *downward* and *outward*, that it is advisable not to allow the split deal splint to extend further than the wrist. In such cases the hand should be suffered to drop as low as possible, before it is confined to the flat part of the back splint. If the hand be confined down in this way, it will act as a lever upon the carpal portion of the radius, and tend to raise it, and thus assist the splints in keeping the carpal portion in a proper line with the humeral. In this variety of fracture, the sling should not be allowed to extend farther than the wrist. The surgeon should take care to ascertain the direction of the fracture, for, if he were to make a lever of the hand in the manner I have pointed out, when the fracture passes through the bone downward and inward, he would be in danger of keeping the fractured surfaces separated from one another, and thereby retard, and perhaps prevent, a union, by the intervention of callus.

When one or both bones are broken near the humerus, it is necessary to be particular in padding the splints, so as to make them bear properly at the seat of fracture.

Fractures ne the humeral ends.

Fractures of the bodies of the bones of the fore-arm, are usually from three to five weeks in uniting. When well managed, the bones unite without deformity, but there is often some stiffness of the fingers after the union of the fracture is completed. This is more or less troublesome according to the situation of the fracture, and the degree of injury which the soft parts have sustained.

Prognosis.

The plan of treatment which I have recommended, I have found very satisfactory. It has been followed in St. Thomas's Hospital and elsewhere for several years, and it will be found not to disappoint the attentive and well-informed practitioner. The influence of the splints is so self-evident, that it does not appear desirable to take up the readers time, by detailing illustrative cases.

CHAP. XI.

FRACTURES OF THE RIBS—CAUSES, SYMPTOMS, NATURE AND TREATMENT.

I SHALL now proceed to speak of fractures of the ribs.

Part usually fractured.

Fractures of the ribs generally happen from blows or falls upon the side, and usually divide the bones through or near the greatest convexity. Sometimes, however, the ribs are broken near the posterior extremity, and sometimes through the cartilages which connect them to the sternum. The first rib is so well protected by the clavicle, and the lower ones being very flexible, are less liable to fracture than those which are placed between them. Occasionally, several ribs are fractured at the same time, on one or both sides.

Displacemen

All the ribs, with the exception of those which are called floating ribs, being connected posteriorly to the spine, and anteriorly to the sternum, those which are fractured cannot become shortened, nor can they be displaced upwards or downwards, in consequence of the attachment of the intercostal muscles. The only direction in which displacement can take place is inwards or outwards.

Symptoms.

When a fracture has taken place, even in the simplest cases, the pleura becomes more or less inflamed. This gives rise to cough, which however not unfrequently comes on immediately after the accident, in consequence, apparently, of the new irritation produced by the fractured ends of the bone prior to the occurrence of inflammation. If we place the hand upon the part where the patient complains of a pricking sensation and desire him to cough, we sometimes feel crepitus; and if we draw the finger along the rib over the painful part, we sometimes feel an unnatural projection; but this of course can only be noticed when the fracture is attended with displacement. If the fracture be attended with displacement, the pleura is often more or less torn, and it not unfrequently happens, that one of the fractured ends is driven inwards, so far as to penetrate the lungs; when this is the case, the air escapes and produces emphysema.

Nature.

A fracture of a rib without displacement is a very simple accident, and one which is not always readily discovered; but when several of the ribs are broken on one or both sides, and when the lungs or one or more of the intercostal arteries are wounded, the injury is veıy dangerous.

Treatment
roller.

The indication in the treatment of fractures of the ribs, in ordinary cases, is to fix the ribs, so that those above and below the fracture shall not be put in motion by the function of breathing so as to give pain. This is commonly done by a wide roller of linen or flannel, placed round the chest, with a sufficient degree of firmness to prevent the ribs from rising during the act of inspiration.

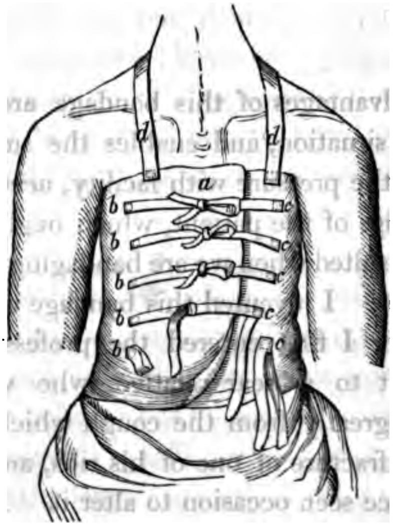
Objection.

I object to this mode of treatment, because the roller gets slack, and requires to be re-applied frequently, and because, when it is applied too tight, it cannot be regulated to the patient's feelings without taking it off and re-applying it. The patient is often much distressed if the roller is applied too tight or too slack, and cannot relieve himself without the assistance of his surgeon.

Author's plan.

I employ a towel (*see a, Fig.* 1), or a wide

Fig. 1.



piece of strong linen, near one extremity of which is fixed tapes, in the form of loops, *b*; and near the other extremity tapes, with two loose ends, *c*, opposite the loops.

Application.

The towel thus equipped, is placed round the chest, and is supported in its proper situation, by means of pieces of linen or tapes, *d*, passed over the shoulders in the form of braces. The surgeon then passes one of the loose ends through the opposite loop, and ties it to the other loose end, and proceeds to tie the other loose ends in the same manner, till the whole of them are fixed with a sufficient degree of firmness to prevent any painful motion of the ribs.

Advantages.

The advantages of this bandage are, that it keeps its situation, and enables the surgeon to regulate the pressure with facility, according to the feelings of the patient, which ought always to be consulted when we are bandaging fractures of the ribs. I invented this bandage about two years after I first entered the profession, and applied it to a near relative, who was then suffering greatly from the cough which accompanied a fracture of one of his ribs, and I have never since seen occasion to alter it. It should be applied with that degree of tightness which gives the patient the greatest ease in the fractured part.

Constitutional treatment.

If we have reason to apprehend that the lungs are injured and inflamed, or that the inflammation is spreading in the pleura, it is right to bleed, and that largely; and the patient should be kept at rest, and be directed to take such medicines as are calculated to keep the bowels in a relaxed state, and to relieve the cough which arises in consequence of the accident.

Treatment when many are broken.

If several of the ribs are broken on one or on both sides, it is improper to apply a bandage of any kind; for, in such a case, the fractured extremities would be pressed in upon the lungs, and not only injure them materially, but in some cases suffocate the patient, by compressing the lungs in such a manner as to prevent the act of inspiration.

Cannot support them.

In these severe cases, we have no means by which we can support the ribs in their proper situation, and we are obliged to trust to such remedies as tend to subdue the inflammatory action. The prognosis in such cases is unfavourable. Patients who have sustained so much injury, generally die from effusion of blood into the cavity of the chest, or from inflammation of the lungs and pleura.

Bleeding from the intercostal arteries.

Occasionally patients die from the effusion which takes place from one or more of the intercostal arteries. This, sometimes happens, where there is only one or two ribs broken. I have myself seen death produced by this cause where three ribs only were found broken. In this case there was no injury of the lungs

Prognosis ordinary c

In general, however, fractures of the ribs, where there are not more than two or three ribs broken, do well. The danger in such cases commonly arises from inflammation of the lungs and pleura, which usually yield to the measures generally employed in idiopathic inflammation of the chest.

CHAP. XII.

INJURIES OF THE SPINAL COLUMN AND SPINAL CHORD.

THE symptoms of the injuries of the spinal chord without fracture are often very similar in many respects to those injuries of the chord which are accompanied with fracture. Concussion of the chord may occur with or without extravasation. Suppuration and ulceration may arise in consequence of injury or disease.

Concussion.

A very severe blow upon the spine, or any great violence by which the spine is suddenly bent, may produce paralysis of the parts beneath, in a degree proportionate to the violence of the injury. Extravasation may occur without concussion, and concussion without extravasation. When extravasation is accompanied by concussion, the voluntary powers will be diminished in proportion to the degree of compression produced on the spinal chord by the effused blood; and, as the blood is gradually poured out, the voluntary power may be gradually diminished, till complete paralysis ensues. Death is sometimes the result of this injury. In cases of concussion, the diminution of voluntary power is immediate, and sometimes the paralysis is complete. When concussion is accompanied with extravasation, either into or upon the sheath of the spinal marrow, it is difficult to say how far the loss of power over the muscles arises from the simple concussion of the chord, or from concussion in conjunction with the pressure produced by the extravasated blood. Persons often recover, though very slowly, from the effects of such injuries of the spinal marrow; occasionally, however, they are so severe as to destroy life.

Fractures of the Spine.

Spinous processes.

Portions of the spinous processes are sometimes broken off without producing any effect upon the spinal marrow, unless attended with considerable concussion. Sir A. Cooper mentions the case of a boy, in whom three or four of the spinous processes had been broken off, and states that the boy recovered, with the free use of his limbs, without any particular attention. The injury produced some deformity of the spine, which continued when he was discharged from the hospital. In a case admitted into St. Thomas's Hospital, under Mr. Travers, the spinous processes, from the fourth dorsal to the twelfth inclusive, were fractured by a fall from a height of about twenty feet. There was found also in this case, after death, a complete rupture of the intervertebral substance, between the sixth and seventh dorsal, with a slight fracture of the fore-part of the body of the sixth vertebra. The spinal marrow was completely torn; the theca, however, remained nearly perfect.

ctures
rough the
h at the root
the spinous
ocesses.

I have seen one instance of this injury. This occurred in a person brought into St. Thomas's Hospital. The patient died soon after his admission, apparently in consequence of the concussion which the spinal chord had received, and from compression, arising from extravasation, as the fractured portion of bone was not sufficiently displaced to press at all upon the spinal marrow.

actures
rough the
dies.

These fractures frequently come under our observation. The symptoms and results of these accidents differ according to the situation of the fractured bone. Sir A. Cooper has divided them into two classes; *viz.* 1st. Those which occur above the third cervical vertebra, and, 2dly, those which take place below that bone. These are accompanied with displacement, differing in degree according to the extent of laceration or separation which the ligaments have suffered. I have little to add to Sir A. Cooper's account of the nature and symptoms of these injuries, I shall, therefore, speak of them, in these particulars, nearly in his words.

Fractures above the third vertebra.

When the fracture happens above the third cervical vertebra, "the accident is almost always immediately fatal, if the displacement be to the usual extent. Death, in the second class, occurs at various periods after the injury. The origin of the phrenic nerve from the third and fourth cervical pair is the reason of this difference; for, as the parts below are paralysed by the pressure upon the spinal chord if the accident be below the fourth cervical vertebra, the phrenic nerve retains its functions, and the diaphragm supports respiration; but, if on the contrary, the fracture be situated above the origin of this nerve, death immediately ensues. It is true, that a small filament of the second cervical nerve contributes to the formation of the phrenic, but is in itself insufficient to support respiration under fracture of the third vertebra.

Fractures below the third cervical vertebra—Lumbar.

"The effects which arise from fracture and displacement of the spine below the origin of the phrenic nerve, depend upon the approximation of the accident to the head. If the lumbar vertebræ be (much) displaced, the lower extremities are rendered so completely insensible that no injury inflicted upon them can be perceived by the patient; pinching, burning with caustic, or the application of a blister, are alike unfelt. The power of volition is completely destroyed; (there is) not the smallest influence over the muscles remaining. The sphincter ani looses its power of resistance to the peristaltic motion of the intestines, and the fæces pass off involuntarily. The bladder is no longer able to contract, and the urine is retained until drawn off by a catheter, and yet the involuntary powers of the limbs remain nearly the same as before; the circulation proceeds, although perhaps somewhat more languidly, but sufficiently to preserve their heat, and local inflammation can be excited in them. A blister applied upon the inner side of the thigh or leg, of which the patient is wholly unconscious, will still inflame, vesicate, and heal, shewing that the involuntary functions may proceed in parts which are cut off from their connexion with the brain and spinal marrow. The penis under these circumstances is generally erect. Patients die from this injury at different periods, according to the degree of displacement of the vertebræ. In general, in fractures of the lumbar vertebræ, the patient dies within the space of a month or six weeks after the injury, and usually, for some time before death, the urine passes off involuntarily, from the extreme debility." Sir A. Cooper alludes to a person in St. Thomas's Hospital, who lived more than two years after this accident, and then died of gangrene of the nates.

Fractures of the dorsal ve tebræ.

In fractures of the dorsal vertebræ accompanied with displacement, "the symptoms are very similar to those described in fractures of the lumbar, but the paralysis extends higher, and the abdomen becomes excessively inflated. This symptom arises from diminished nervous influence in the intestines; for, though their peristaltic motion can proceed independent of the brain and spinal marrow, yet it is quite certain that the involuntary functions of the intestines, like those of the heart, can be influenced by the brain and spinal marrow; for we see even states of the mind producing affections of the intestines, one state rendering them torpid and another irritable, as we see the heart leaping with joy and depressed by disappointment; we, also, observe pressure on the brain rendering the intestines very difficult of excitement, even from the influence of the strongest aperients. From displacement of the dorsal vertebræ, death sooner succeeds than in similar injuries to the lumbar, the patient usually not surviving the accident more than a fortnight or three weeks." Now and then, however, the patient lives much longer. Sir A. Cooper mentions the case of a gentleman, who lived rather more than nine months after the injury. The period of existence is regulated according to the situation of the fracture, whether it be near or distant from the cervical vertebræ, and the degree of displacement; and, also, according to the degree of injury which the spinal marrow has sustained.

ractures of
he cervical
ertebræ.

"Fractures of the cervical vertebræ below the origin of the phrenic nerve, produce paralysis of the arms, as well as of the lower parts of the body, but this paralysis is seldom complete; if the fracture occur at the sixth or seventh vertebra, the patient has some feeling and powers of motion, but if at the fifth, little or none;

sometimes one arm is much more affected than the other, when the fracture is oblique and the axillary plexus of nerves is consequently partially influenced. Respiration in these cases is difficult, and performed wholly by the diaphragm; the power of the intercostal muscles being destroyed by the accident. The abdomen is also tumid from flatulency, as when the dorsal vertebræ have sustained injury. The other symptoms are the same as in other fractures of the vertebræ below the cervical, as regards the lower extremities, the bladder and the sphincter ani. Death ensues, in these cases, in from three to seven days, as the fracture may happen to be seated in the fifth, sixth, or seventh vertebra. I have scarcely known the subject of this injury to live beyond a week, and but rarely to die on the second day, although they sometimes do if the fifth cervical vertebra has sustained the injury. I have already stated that, in fractures and displacements above the fourth cervical vertebra, death instantaneously follows."

Dissection.

The following appearances present themselves upon dissection in cases of fracture of the vertebræ accompanied with displacement of the bodies. "The spinous processes of the displaced vertebra is depressed, the articular processes are fractured, the body of the vertebra is broken through, for it but rarely happens that the separation and displacement occur at the intervertebral substance. The body of the vertebra is usually advanced from half an inch to an inch; between the vertebræ and the sheath of the spinal marrow, blood is extravasated, and frequently there is blood extravasated upon the spinal chord itself. The spinal marrow is compressed and bruised in slight displacements, and is torn through when the injury is very extensive, but the dura mater remains whole. A bulb is formed at each end of the lacerated spinal marrow, which laceration is usually produced by the bony arch of the spinous processes."

Treatment.

Mr. H. Cline considered these cases to be similar to fracture with depression of the cranium, and, in order to obtain relief, he thought it would be necessary to remove that portion of the vertebra by which the spinal chord is compressed; and, as the cases had proved so uniformly fatal, he thought himself justified in stepping out of the usual course, with a hope of preserving life. He made an incision upon the depressed bone, as the patient was lying upon his breast, raised the muscles covering the spinal arch, applied a small trephine to the arch, and cut it through on each side, so as to remove the spinous process and the arch of bone which pressed upon the spinal marrow. He lived to try this operation only in one case, in which it did not succeed. The same operation has been performed several times since, but with no better result.

I do not anticipate that any good will be found to arise from this operation, at least during the early stage of the injury. The operation is in itself very severe, and converts a simple fracture into the state of one which is compound, and subjects the patient to all the consequences of a fracture of this description, in a part, too, much more necessary to life than the extremities, in which compound fractures most commonly occur. I do not mean these observations in the way of blame, but throw them out with a view to discourage a mode of proceeding which has never, as far as I know, been productive of any good. When cases prove so constantly fatal, surgeons consider themselves justified in trying desperate modes of treatment with the laudable hope of being instrumental in preserving now and then a person from an untimely grave. I am disposed to think, however, that, in cases of fracture of the spine, a milder mode of management, which I have to mention, will be found more frequently beneficial.

Indications.

The indications in cases of fracture of the spine that require our immediate attention, are, 1st. To bring the displaced parts as nearly as possible into their natural position, and prevent them from being moved. 2dly. To remove local inflammation. 3dly. To attend to the state of the system generally, and particularly to the condition of the bowels and bladder.

Authors' treatment.

The first indication I endeavour to answer by means of my fracture-bed. (*See page 211*). When this bed is used for fractures of the spine, it is necessary that it should have a hole in the upper plane and in the mattress, large enough to enable the surgeon to apply any thing to the injured part that its varying condition may require. This hole is closed with a pad, properly constructed, and a trap-door made to fit the hole. The mattress should be covered with a blanket and sheet, as above described, which of course should be cut through and tacked, so as to admit of easy access to the spine through the trap-door in the upper plane.

The bed having been properly prepared, place the upper plane to lie horizontally, and the middle and lower planes at an angle, and then lay the patient upon the bed, with the perineum opposite the hole in the middle plane, and the fractured portion of the spine opposite the hole in the upper plane. When this is done, observe the position of the spine, and see whether it lies in as straight a line as it can be brought by raising the angle formed by the middle and lower plane; if not, vary it a little, in order if possible, to cause the fractured surfaces to fall into their natural position. This having been done, place the head with the face supine, and fix it in this position, with a bandage carried from the side of the patient's night-cap to the side of the bed. Care should be taken that the skin at the back of the pelvis is not much pressed upon by the superincumbent weight. If this direction be neglected, very serious mischief may arise from inflammation or sloughing. In order to avoid these evils, the length of the middle plane requires to be regulated with nicety, so that the weight of the lower limbs and part of the weight of the pelvis may be supported by the lower planes, over which the limbs are placed. The patient may lie in this, the most favourable position for any desirable length of time without any danger of injury from partial pressure, and need not be moved either for the purpose of taking away the fæces and urine, or to enable the surgeon to apply any thing that may be deemed advisable to the injured part of the spine.

The inflammation which supervenes should be subdued by the employment of leeches, which should be applied with as much freedom as the circumstances of the case will justify; and by the administration of aperient medicines. Bleeding from the arm may be advisable, in some instances, where the febrile excitement is great. The food should be light and farinaceous. The constitutional treatment must be regulated by the state of the patient, and the urine should be drawn off, by means of a catheter, every five or six hours. A flexible catheter may be left in the bladder for this purpose. The young surgeon should remember that the bladder has lost its power of acting, and should therefore always take care to press upon the abdomen over the region of this viscus when he is removing the urine.

The following case will serve to illustrate the effects of this mode of treatment when conducted with care.

Nov. 24, 1829.—A boy, aged 15, was admitted into St. Thomas's Hospital, under Mr. Green, with symptoms of compression of the spinal chord. He stated that, as he was passing under a crane, a barrel fell and struck him down; the blow was received between the shoulders. He was taken up, being unable to rise, and brought immediately to the hospital. Case.

The symptoms in this case were as follow:—Total loss of voluntary muscular power in the lower extremities. Sensation considerably diminished as high as the ribs, but not entirely lost. The costal and abdominal muscles were completely paralysed, and respiration was carried on entirely by the diaphragm. He experienced great pain in the upper arm, extending in the course of the brachial nerves. The pain in the axillæ he describes as similar to round bodies pressing in that situation. There was weakness felt in the arms and neck. The bladder was paralysed, and priapism was present. On examining the spine, some depression of the spinous process of the second dorsal vertebra, attended with mobility and crepitus, was perceptible. Mr. Green was of opinion, that the injury was a fracture of the body of the second or upper part of the third dorsal vertebra. He was ordered a saline mixture in connexion with an anodyne, and twelve leeches to the injured part.

On the 25th, a consultation of the surgeons of the hospital took place, and it was determined that the boy should be kept quiet. At Mr. Green's request, I had my fracture-bed made ready for him in the manner above described, and superintended his being placed upon it, which was done in the afternoon of the same day, as I have recommended. Aperient medicines were administered, and twenty leeches were applied to the spine in the region of the fracture, through the opening in the upper plane of the fracture-bed. His urine was ordered to be drawn off every six hours. He complained of the abdomen being tense, though it was not so to the touch.

26th.—The leeches had bled freely, and he had had three copious evacuations. He had now more sensation, and some slight return of voluntary power in the extremities. The urine was acidulated.

27th.—Stated that he passed a small quantity of urine without assistance. He had a slight cough on the 25th, which still continued to tease him. He slept well; his appetite was good; diet light.

29th.—He felt perfectly easy, and had gained more power in the left leg, but had still very little in the right. Had not passed any urine without the assistance of a catheter since the 27th.

Dec. 3.—Muscular power gradually returning, but more rapidly in the left limb than in the right. Numbedness principally in the right limb and over the abdomen. His bowels were torpid, and required the aid of aperients.

8th.—Muscular power increased. The abdominal and intercostal muscles had begun to assist in respiration.

12th.—The cough and expectoration had subsided. Sensation in the left limb was now nearly natural, but the right limb still continued numb, and he had very little power over its muscles.

15th.—Had been wearing a catheter, which was still kept in the bladder. The numbedness had quite left the right leg. The abdominal and intercostal muscles act freely.

20th.—Improving—placed on the common diet of the hospital.

24th.—Appetite good. The pulse unaffected by the more generous diet. He had, for the previous two evenings, passed a considerable quantity of urine without the catheter.

30th.—Was now able to pass his water altogether without assistance. Voluntary muscular power was increasing gradually. The right limb continued much behind the left in power. His bowels were kept open, by a table-spoonful of castor oil given every night.

January 18, 1830.—The bowels had now acted regularly without aperients for about ten days. The left limb had still the precedence of the right. His urine, which he passed without assistance, was neutral. Health very good.

25th.—Was moved by Mr. Green's desire to a common bed, with permission to turn on his side, but had strict orders to retain the recumbent posture.

February 9.—He was allowed to get up and move about with crutches.

28th.—At this time he was able to walk a little without assistance. He could not put out his right leg so freely as the left, and had a peculiar fall of the right shoulder.

April 5.—He could walk well at this time, but still made shorter steps with the right leg than with the left, and occasionally dropped the right shoulder. He still stooped a little forward, but there was now no pain experienced in the back, nor any irregularity of the spinous process to be observed.

This boy called at the hospital a short time ago, and was then perfectly restored.

CHAP. XIII.

FRACTURES OF THE PELVIS.

FRACTURES of the pelvis are not common accidents; but, when they occur, are for the most part of a very serious nature.

uses. The causes which give rise to these injuries are various, but they are always referable to external violence; such as falls from a great height, the passage of heavy carriage-wheels over the pelvis, &c.

ymptoms. Fractures of the pelvis are distinguished by displacement or crepitus, or both; but it is sometimes difficult to ascertain precisely through what part the fracture has taken place.

actures of e sacrum. When the sacrum is fractured, there is no danger of displacement from the action of muscles. The principal danger depends upon the injury which the pelvic viscera and nerves may b [illegible] from the violence which occasioned the fracture. Hence, often proceed retention of urine, inability to retain this fluid, involuntary discharge of the fæces, paralysis of the lower extremities, &c.

Fractures of th
os coccygis.

This bone is occasionally broken when the fracture arises from a fall on the buttock; the pain occasioned by the injury is increased by walking, in consequence of some fibres of the glutei being attached to this bone and disturbing it when in action.

Fractures of th
ossa innomin
ta and pubes.

Fractures of these bones are attended with considerable contusion of the external soft parts, and sometimes with great injury of the pelvic viscera; sometimes the os ilium, the os ischium, and the os pubis are found fractured in the same person. The degree of displacement commonly depends upon the degree of laceration which the soft parts have sustained. When the contusion is great, and the bones very badly broken, the patient suffers greatly when any motion is given to the body. Occasionally the bladder is wounded, or the urethra torn through or opened.

Sir A. Cooper observes that, " when the fracture of the os innominatum happens through the acetabulum, the head of the bone is drawn upwards, and the trochanter somewhat forwards, so that the leg is shortened, and the knee and foot are turned inwards; such a case may be readily mistaken for dislocation into the ischiatic notch. If the os innominatum is disjointed from the sacrum, and the pubes and ischium are broken, the limb is a slight degree shorter than the other; but in this case, the knee and foot are not turned inwards but outwards."

Treatment. The treatment usually advised, is very inadequate to answer any of the indications which present themselves in these cases; and I think, from this cause, many instances of death have occurred, which, under a more favourable management, might have been prevented.

The two great indications in all cases of fracture of the pelvis is to reduce the parts into their natural position as nearly as possible, and keep them there in a state of perfect quietude; and to guard against inflammation of the pelvic and other neighbouring viscera. When the sacrum or os coccygis is displaced inward, it should be reduced by the finger per rectum, or per vaginam, but without violence.

A bandage, placed closely round the pelvis, as usually recommended, is likely in some cases to do more harm than good, by driving the broken portions of the bones in upon the viscera. Whatever support, therefore, of this kind is given, it should be regulated by the conditions of the fracture. I would recommend the surgeon, in all cases of this description, to have recourse to the fracture-bed above described. I should place the patient upon it, with the upper plane nearly in the horizontal position, and the two lower planes at an obtuse angle. The middle plane should be elongated, so that the gentle strain upon the thighs, made by the weight of the legs lightly resting upon the lower plane, might prevent any uncomfortable pressure from being made upon the back of the pelvis. The sides of the pelvis should be gently supported by pads, if necessary. This I should always recommend to be done when the ilia are fractured. The thighs should be approximated, and the feet kept upright. If the urethra or bladder be injured, a flexible catheter should be worn. Care should be taken also to draw off the urine at proper intervals should the bladder be rendered paralytic. The bowels should be kept in a comfortably relaxed state, and when inflammation supervenes more active measures should be resorted to. Blood should be drawn from the arm, and by leeches as occasion may require.

Case.

Some time ago there was a man admitted into St. Thomas's Hospital, under Mr. Green, with a very bad fracture of the pelvis, accompanied with laceration of urethra and perineum. The man suffered greatly when the least movement was given to the body. I did not take notes at the time, nor can I bring to memory only a few particulars of the case. He was placed upon my fracture-bed very soon after his admission, in the manner I have pointed out, and treated as the circumstances required. A flexible catheter was kept in the bladder, through which the water was allowed to drain off. For a considerable time after the injury, the urine was mixed with blood. The wound in the urethra and perineum ultimately healed, and the man was so far recovered, that it was thought he might be removed to a common bed. This was done, but it was soon ascertained that the union which had taken place was not sufficient to support the parts in their natural position. One of the limbs began to be drawn up, and appeared shorter than the other, from the displacement of the fractured bones. It was proposed to the man that he should be placed again upon the fracture-bed, but he declined, as he desired to leave the hospital, which he had been anxious to do for some time previous. I saw him some months after he left the hospital, and the limb had now become retracted several inches. The man was quite helpless. The femora were free from injury.

Remarks.

It was found in this case, that the fracture-bed gave the surgeon great command over the fractured bones, and enabled him to prevent retraction, and at the same time to support the patient in that position most comfortable to himself.

Prognosis.

The prognosis in fractures of the os sacrum and ossa innominata, has been commonly unfavourable, and will continue to be so when the viscera are injured; but should they escape injury, or be not irreparably lacerated, I think that the plan of treatment which I have advised will be the means of saving many lives which would otherwise be lost, as it enables the surgeon to keep the parts in a state of perfect quietude, and thereby prevent that horrible pain and destructive inflammation which arise from the movement of the broken portions, and the consequent pricking and tearing of the contiguous textures.

CHAP. XIV.

COMPOUND FRACTURES.

SEC. 1.—*The Nature of Compound Fracture—The usual Modes of Treatment—Local—Constitutional.*

Definition.

BY compound fracture, I mean a fracture with a wound leading from the fracture through the soft parts to the external surface.

Some simple fractures attended with more laceration than compound.

When speaking of the different varieties of fracture in a former chapter, I remarked that the only specific difference between a simple and a compound fracture consists in the wound which always accompanies the latter. There are many compound fractures attended with much less laceration, much less contusion of the surrounding parts, and consequently much less mischief than we observe in some simple fractures. But we may lay it down as a general rule, that compound fractures are attended with much more laceration and contusion than sim-

Compound commonly more serious injuries.

ple fractures, and, even upon this consideration alone, are commonly much more serious injuries.

Of the propr
ty of amput
ing.

When called to a case of compound fracture, the first question which arises is, can the limb be saved; or, in other words, can we attempt to save the fractured limb with safety to the patient's life? This is a question of great importance, and one which requires immediate determination—every moment of delay is, in many instances, to the patient's disadvantage, and frequently a very short space of time makes all the difference between probable safety and fatality. If these cases in general would admit of deliberation for two or three days without adding to the patient's danger, and during that time such symptoms might be expected to arise as would with certainty point out to the scientific surgeon the conduct which he ought to pursue, the difference in a surgical point of view would be considerable; and could such delay be allowed with impunity, the surgeon would not seem to be so precipitate in his determination as he is frequently thought to be; and should amputation be advised, the patient and his friends would become more convinced of its necessity, and the patient would be induced to submit to it with little comparative reluctance. But, unfortunately for both parties, this is seldom the case. If we do not embrace the first opportunity, we are frequently denied another. Here, therefore, the whole exertion of a man's penetration and judgment and firmness are required; here these mental powers must be concentrated, that he may neither rashly nor unnecessarily deprive the patient of a limb, nor through a false tenderness or timidity suffer him to perish, by endeavouring to preserve a limb which he ought to lose.

Circumstances which render amputation necessary.

Many circumstances may accompany a compound fracture, which would render the operation of amputation necessary. Great comminution of bone, with great laceration and contusion of the soft parts, accompanied with extensive wounds leading to the fractured part, demand immediate amputation. There may be some gentlemen who have a very imperfect notion of the appearance of cases which I have said require immediate amputation. Unfortunately we cannot, in speaking of these cases, convey clear ideas to those who have never witnessed them. We are obliged to make use of comparative terms, of whose import the experienced surgeon only is a competent judge.

A man who has seen the colours black and red, knows well what is meant by the words black and red, when mentioned to him in his own language; but it would be difficult to convey to a man who has never seen the colours, the precise idea which these words designate: so a surgeon, who has seen that degree of comminution of bone, laceration and contusion of soft parts, which requires amputation, and who has witnessed the influence of age and constitution upon persons who have suffered severe injuries, comprehends what is meant by the terms used to represent these states; he knows, too, that one person would suffer little from a degree of organic injury which would destroy another; but it is a difficult matter to convey in words only, the same impressions to a man who has never been assisted by actual observation.

Again; a man unaccustomed to contemplate colours, would readily distinguish the colour black from blue, when he had once seen them, if the difference be great; but he would pass over minute shades of difference which the experienced eye would immediately detect: so it is in many cases of medicine and surgery—so it is in compound fracture. The inexperienced surgeon may form a correct judgment in extreme cases, as when the limb is crushed to pieces by the broad wheel of a heavily laden waggon, or by the force of a heavy weight, as that used to drive piles; but in many cases he cannot see differences in the degrees of severity, which require to be seen and well weighed before a correct judgment can be formed.

Recollect, this is no trifling matter:—It is a question of curing or maiming; of life or death. If a correct judgment be given and properly acted upon, the limb will be cured, and the life will be preserved, or the limb will be amputated, and the life saved. If it be incorrectly determined, a limb which ought to have been saved will be lost, or a limb which should be amputated will be attempted to be saved, and death will be the probable result. I mention these facts, to induce the students of surgery to attend strictly to these cases in our hospitals, while they have a nopportunity of doing so; for, in practice, we find that the lives of our patients frequently depend upon the correctness of our judgment.

Extending into a large joint.

When the fracture extends into a large joint, as the knee or ancle-joint, less injury to the soft parts renders amputation advisable, than when it is situated in the middle of a bone.

Attended with a wound of the artery of the limb.

When the fracture is attended with a wound of the principal artery of the limb, as the humeral or femoral, amputation should be immediately performed; so, in general, if it be attended with a laceration of the posterior tibial. Now and then a compound fracture, accompanied with a wound of the posterior tibial artery, may be cured; but such recoveries are rarely met with, and should never be attempted unless every other circumstance be very favourable.

Influence of age and constitution and habits.

Before we make up our minds upon the propriety of amputating, we must carefully consider the age, the constitution, and the habits of the patient; always bearing in mind, that growing persons, after the age of two years, bear injuries much better than adults, and adults much better than old people.

Old persons bear injuries very badly.

Old persons bear injuries very badly. They sometimes die of simple fracture, unaccompanied with symptoms of severity. Even the shock produced by a simple fracture, is often too great for the powers of the constitution, in persons at a great age, to get over. They fall into a state of collapse, and die with apparently as much ease as they fall sleep. In such persons, therefore, compound fractures are much less likely to do well than in children or adults.

Also persons of irritable habits or who have abused their constitution.

Persons who have abused their constitutions by hard drinking, and persons whose constitutions are naturally irritable, are unable to support bad organic injuries. They often die from comparatively slight accidents. Attempts to preserve the limbs of such persons, with bad compound fracture, have been most frequently frustrated by the death of the patient.

Such are the observations which it is proper to bear in mind, when we are called upon to form a judgment as to the propriety of amputation. If it be found necessary to amputate, the operation should not be delayed. The sooner the limb is removed, after the accident, the better the patient is likely to bear it.

Bad cases sometimes get well.

It may be said, and most practical surgeons are aware, that limbs so shattered and wounded as to render amputation the only probable means for the preservation of life, are now and then saved; but such escapes are very rare; much too rare to admit of being made precedents, and when they are met with, they are found to occur in persons who bear pain well—whose irritability is not easily excited.

Reduction of the fracture.

We will now suppose that the limb is thought capable of preservation; our next consideration is the reduction of the fracture. The ease or difficulty attending this, depends not only upon the general nature of the case, but on the particular disposition of the bone with respect to the wound.

Easily reduce if the fracture ends do not protrude.

If the fractured ends do not protrude, the trouble of reducing them and placing them in proper apposition, will be much less than if the case be otherwise. If one or more of the fractured ends protrude, the difficulty of reduction is always in proportion to the comparative size of the wound through which the bone has passed. In a compound fracture of the leg or thigh, it is almost always the upper portion that protrudes. If the fracture be of the transverse kind, and the wound large, a moderate degree of extension will in general easily reduce it; but if the fracture be oblique, and terminate, as it often does, in a long sharp point, the fractured end makes its way through an opening no larger than itself. When this is the case, if we place the leg in the straight position, in order to make extension, the soft parts in contact with the protruded portion gird it tight, and make all that part of the bone which is external to the wound, press hard on the skin of the leg beneath it. Under these circumstances, all attempts at reduction will be found to be impracticable—the more the leg is stretched out, the more the bone will be begirt by the integuments.

metimes ne-
ssary to saw
f part of the
ne.

When this happens, it is sometimes advisable to remove part of that portion of the bone which protrudes, by means of the saw; this is only necessary when the protruding portion is very pointed, and then only a small piece of the end should be sawed off. If after this it is found that the end of the bone is not likely to be disengaged by extending in the straight position, the position should be altered, so that, if possible, the integuments may be made to slip off the bone. If the end of the bone cannot be easily reduced, it is better to enlarge the wound, as this is found to be much less in-

metimes to
large the
ound.

jurious than violent extension—of course the wound must be made large enough to allow of easy reduction.

Removal of splinters.

If, in comminuted fractures, any of the splinters of bone are found totally detached and lying loose in the wound, they should be removed; but they should be taken away with all possible gentleness, without laceration or other violence, without the risk of hemorrhage, and with as little poking into the wound as possible. The whole of this part of the treatment of a compound fracture should be executed with great caution. The practitioner should always remember, that if the parts surrounding the fracture be much torn in the act of removing the splinters, it is exactly the same to the patient, and to the event of the case, whether such violence be the necessary consequences of the fracture, or of his unnecessary or awkward manner of poking into the wound.

General indications of treatment.

The general indications in the early treatment of a compound fracture, as far as the limb is concerned, are to keep the fractured ends of the bone, when once placed right, at rest in their natural position, to produce adhesion of the wound leading to the fracture, and to keep down the active inflammation.

Usual means inadequate.

The contrivances commonly made use of in the management of compound fractures, are the fracture-box, Assilini's trough, and Sharp's splints. I have already stated the inadequacy of these means to keep the bones quiet and in their natural position in simple fractures; therefore, I need only state here, that if they do not keep the fractured extremities at rest and in their proper apposition in simple fractures, we cannot expect that they can be so applied as to do so with any degree of certainty in compound fractures, which, as I have said, are usually attended with much more laceration than is observed in simple fractures, and consequently require more effectual means of support.

The adhesion of the wound.

Upon the treatment of the wound of a compound fracture, surgeons have varied much in their opinions. In dressing the wound of a compound fracture, says Mr. Pott, "we mean to maintain a proper opening for the easy and free discharge of gleet, sloughs, matter, extraneous bodies, or fragments of bone; and this in-such a manner and by such means, as shall give the least possible pain or fatigue; as shall neither irritate by its quality nor oppress by its quantity, nor by any means contribute to the detention or lodgment of what ought to be discharged. The dressing for the wound can consist of nothing better, nor indeed so good, as soft dry lint, laid on so lightly as just to absorb the sanies, but neither to distend the wound, or be the smallest impediment to the discharge of matter. This lint should be kept clear of the edges, and the whole of it covered with soft easy digestive." From this description, it is evident that the lint can have no effect upon the wound, further than what may be derived from the absorption of the bloody serum, which always exudes from the surfaces of the wound of a compound fracture till suppuration is established. Yet, it would appear, that Mr. Pott was not insensible to the advantages of producing adhesion of the wound; for he says, our treatment of the limb should be such as to prevent or remove inflammation, in order, "if the habit be good and other circumstances fortunate, that the wound may be healed by what the surgeons call the first intention—that is without suppuration or abscess."

Lint the best application.

Sir A. Cooper, when speaking of the early treatment of the lacerated wound in compound dislocation of the ancle, states that " when the bone has been reduced, a piece of lint is to be dipped in the patient's blood, and applied wet over the wound ; upon which the blood coagulates and forms the most natural, and, as far as I have seen, the best covering for the wound." Sir A. Cooper here adopts the opinion of Mr. Hunter, and adds weight to that opinion by following it in his own practice.

I most cordially agree with these eminent surgeons in the belief, that lint dipped in blood is the best application to the wound. I have repeatedly seen its good effects ; but it is to be regretted that so little has been said upon its modus operandi. We all know that a cut finger, suffered to remain wrapped up in the rag which is at first placed round it, heals readily without any further dressing. This is a fact upon which I proceed in the treatment of incised wounds—nay more, it is one upon which I commonly act in the treatment of lacerated wounds, while I think there is any chance of preserving the injured part, whether the edges of the wound can be brought into contact or not ; and I have proved, by repeated trials, that lint soaked in fresh blood is the best application to the wound that has hitherto been employed.

I was called to a man with a compound fracture of the leg, which was very loose. When I first saw him, about twenty-four hours after the accident, the limb was much swollen, and the fractured ends of the bone much displaced. The pulse was quick, and the fever increasing. I first reduced the bones, and fixed them in their natural situation; but the edges of the wound, which was about an inch in diameter, could not be brought together. The wound, which was filled with blood, I covered with layers of lint soaked in fresh blood; and over these I applied a layer of dry lint, and left the limb in the straight position, with the heel of the apparatus raised so as to make it form an inclined-plane. I now directed an aperient, which in the course of a few hours, acted upon the bowels. When I saw this man the next day, I found the constitutional irritation much less, and he had had some sleep. On the third day, the pulse was much diminished and the swelling of the limb had much decreased; the pain he said was trifling; scarcely more than a sensation of tenderness remained in the wound. On the tenth day, I observed a little discharge of matter Case.

stained with blood, from under the lint which formed the first dressing. I now softened the lint with warm water and removed it, and had the happiness to find that the wound was filled with granulations to a level with the skin.

Case.

In another case of compound fracture into the ancle-joint, in which the wound was at least two inches in length and part of the integuments torn away, the same practice was followed with the same result. I have repeatedly tried this plan of dressing with the same success, and I am disposed to think the same results will happen in nine cases out of ten, even where the integuments cannot be approximated, provided that the surfaces of the wound are not deprived of their vitality, or so much injured as to be incapable of maintaining a healthy action. I have seen the wound filled with granulations, when the first dressing was removed, even when the bone has been much shattered, and many splinters have afterwards come away. It is, indeed, sometimes astonishing to see the rapidity with which large lacerated wounds close up under this plan of treatment, if properly pursued. But why is this?

In what way

This is a question which has never been

does lint prove so beneficial.

answered by any author with which I am acquainted. Yet there must be a vast difference between this mode of dressing, and the application of simple ointment spread on lint. But what does this difference consist in? Is there any thing so irritating in a mixture of wax and olive oil as to produce extensive inflammation and consequent suppuration, perhaps gangrene, in wounds of this description? No. Is there any thing so very soothing and healing in bloody lint as to cause the parts beneath to throw out a luxuriant crop of healthy granulations which speedily close the breach of continuity? Certainly not. What then does all this difference consist in? *In my humble opinion, it consists in excluding the external air from the surfaces of the wound, and from the fluids in its cavity.* The blood coagulates upon the lint, stops up its pores, so as to render it impervious to the surrounding air; and when the lint, wet with blood, is applied to the wound, it adapts itself to the form of the parts with which it comes in contact, and, as it gets dry, it adheres so closely to the skin, that the wound becomes completely sealed up. It might be said, that these advantages are derived from some other cause, and not the exclusion of the external air. But what is the principal argument against this opinion? That air, blown into the cavities or into the cellular membrane, becomes absorbed, and does not irritate. This argument, at first view, would seem to overthrow the opinion I have advanced; but when we investigate it a little closer, we shall see how far it is deserving of our attention.

State of healthy cavities differs from the state of wounds.

The surfaces of the cavities in a natural state, and the surfaces of the healthy cellular texture, are under circumstances very different from the surfaces of a contused wound. In the first, the vessels are entire and in a healthy state, and we cannot expect that such a stimulus would be likely to bring on inflammatory action in a part where there is no disposition to disease; but the surfaces of a wound become inflamed, and then the stimulus of the air, though slight, is sufficient to irritate them, and increase the inflammation. We know that substances which are natural to a part in a healthy state irritate it when it is inflamed, so as to increase the inflammation. What is the effect of taking food into an inflamed stomach? An increase of pain and vomiting. What is the effect of pouring urine into an inflamed bladder? Pain, and a great desire to evacuate it. Air comes in contact with the lining membrane of the air-tubes at every inspiration, and, while it is in a healthy state, it does not irritate; but when the membrane is inflamed, the air becomes an irritant. So in a wound which becomes inflamed as a necessary prelude to its healing; if it cannot defend itself by scabbing you increase the inflammation by the admission of even so slight a stimulus as the air.

Is the air a stimulus?

But still it may be said, that common air is not a stimulus to the textures of animal bodies. Those who still doubt, I would recommend to attend to the influence of those materia medica which are admitted on all hands to be stimulants, and they will observe that a common property of them is to give pain, to cause the part to smart, to increase the heat, &c., when applied to tender surfaces in a state of inflammation; and, having made up their minds upon this point, let them attend to the influence of air upon a part recently denuded. When a blister is taken off and the cuticle remains entire, but separated from the cutis, the patient feels but little difference from the removal of a blister; but if you remove also the cuticle, the serum and coagulable lymph, you will then commonly find that the patient will complainof much pain. The pain indeed to some people, is very severe. Those who doubt the evidence of what they see, may try the experiment upon themselves, and this, I think, they will find convincing.

Action of the air upon the extravasated fluid.

However, even if we were to waive the direct influence of the air upon the torn and tender surfaces of a lacerated wound, which I can by no means consent to, we have yet another evil arising from its admission into the wound, which far outweighs that already mentioned, *viz.* the chemical effect it produces upon the fluids in its cavity. We know that blood and serum are sometimes effused in large quantities in simple fractures and other injuries, and that, in the course of a few days or weeks, according to the quantity poured out, they are altogether removed by the absorbents, without producing irritation. I have seen large collections of blood—I mean to the amount of several ounces—removed in this way, in the course of two or three weeks, without any unpleasant symptom. Now, if the bruised cavities in which such blood was contained had been opened, it is more than probable, that the surrounding parts would have sloughed; and if they would not have sloughed, they would have become very troublesome and painful wounds. This is not a mere opinion—it is fact, experience proves it. Then how comes it that there is all this difference, as far as respects the restoration of the part, between an injury of the soft parts not laid open to the air, and an injury accompanied with an external opening through which the air has ready access? In the one, blood and serum are effused; but, remaining surrounded and in contact with vital parts, and excluded from the action of chemical agents, their vitality is preserved. Surgeons well know that when a large artery is tied at a distance from any branch, as for the cure of aneurism, that the blood coagulates immediately above the ligature, probably because it is not kept in motion; but be this as it may, a coagulum forms, and being in contact with the internal coat of the artery, its vitality is not destroyed: so in a wound which is excluded from the air, we have vital surfaces in contact—the surfaces of the effused blood are in contact with the surfaces of the wound. They mutually agree and assist in the restoration of the part—the vitality of the blood assists in supporting and maintaining the healthy action of the wound, and the vital surfaces of the wound maintain the vitality of the blood. They agree so well, indeed, that, Mr. Hunter, and other surgeons of the present day, myself among the number, have found that vessels shoot from the surfaces of the wound into some of the coagulated blood, which gradually becomes organized and altered in appearance.

The clot decomposed.

But the state of things is very different if we expose the contents of the wound, to the action of the air. The vitality of the blood, already weakened by extravasation, is now speedily destroyed, and the clot soon runs into a state of putrefaction, or in other words, is speedily decomposed. The coagulum dissolves in the serum, and is discharged from the wound in the state of putrid bloody sanies. *Now*, instead of a vital coagulum in contact with the surfaces of the wound, we have an irritating fluid particularly offensive to the textures of the animal body. This fluid increases the inflammation, which in the most favourable case terminates in suppuration; but if the constitution be bad, and the vital powers much weakened by contusion, gangrene is a frequent consequence.

Most common cause of dangerous symptoms.

I feel satisfied, that the dangerous constitutional symptoms which so often accompany compound fracture, ought to be attributed more to the treatment commonly adopted, than to the nature of these injuries.

I have pointed out the advantages which are derived by excluding the air from the wound; these advantages are often lost to the patient from the careless manner in which the wound is dressed, and from other causes, which I shall now attempt to explain.

Causes.

I have already attempted to make my readers acquainted with the inadequacy of the common mechanical contrivances, in the treatment of simple fractures. If, then, these means are not calculated to keep the bones at rest and in their proper position in loose simple fractures, can we for a moment expect that they can be so applied as to prevent motion of the broken extremities in compound fracture? Compound fractures are regarded as much severer accidents than simple fractures; they are commonly attended with more laceration of the soft parts, and the bones are consequently more liable to be displaced by the action of the muscles attached to them, and by every motion of the body and of the limb, whether intentional or accidental. In simple fractures, there is commonly but little starting or convulsive action of the muscles; but in compound fractures, this is sometimes very great: the patient too is more restless, and, therefore, more care should be taken to prevent the influence of his movements upon the fracture. How should we restrain the motion of the fractured bones, or prevent the influence of the motions of the body upon the fracture? By binding the splints tight upon the limb? No, no—such practice in a bad compound fracture would quickly send the patient to his grave. I have said that, *during the existence of active* inflammation in simple fractures, we should be careful not to compress the limb, so as to impede the circulation; but we must be trebly careful of this in compound fractures. Surgeons know that pressure cannot be borne in these cases; they, therefore, direct that the limb should be placed upon a splint, and the proper dressings applied. If the fracture be in the leg, the limb is placed upon a fracture-box, or in one of Assilini's troughs, or, which is, perhaps, more common, it is placed between two splints, and laid on the outer side, in such a manner that the muscles are left almost at full liberty to act upon and displace the fractured ends.

Motion and displacement.

Now mark the effects of this practice. The muscles displace the fractured ends of the bone, and force them amongst the soft parts, already in many cases so bruised and torn, that they could with difficulty recover their healthy state, even under the most favourable treatment. If the ends of the bones were kept quiet, and the patient otherwise well treated, they may do so, and all would be well; but here the muscles are the source of their own destruction, and often even of the destruction of the patient. They force the fractured ends of the bone into their own substance, and into the substance of all the contiguous textures. The broken extremities, pricking and tearing the parts with which they come in contact, greatly increase the inflammatory action and consequent fever. The result of this is generally a profuse discharge of matter, which frequently reduces the patient so much, that we are obliged at last to amputate the limb to save his life. This discharge is sometimes accompanied with extensive sloughing of muscle, tendon, &c. which, if the patient survive and the limb be saved, so destroys the mechanism of the limb, that the unfortunate sufferer is deprived of the use of it for years, and sometimes for life. But more frequently gangrene comes on in the wound, and proceeds up the limb with rapid strides, and soon cuts off the patient.

Surgeons of experience so dread the mischief which arises from the displacement and motion of the bone, that when they have once laid the limb upon the splint, they are afraid to lift it off again. They desire the patient not to move from the position in which he is placed. Some give opium, with the double purpose of keeping the patient quiet and locking up his bowels, lest he should be obliged to use the bed-pan for the first three or four days after the accident, at the end of which period, the constitutional irritation is commonly very great.

ffects of keep-
g the limb
pon the side.

Now mark carefully the results of keeping the limb thus upon the side, and the patient with his bowels confined. First, then, if adhesion of the wound does not take place, there will be more or less discharge ; and no surgeon I presume is ignorant that this is sometimes profuse in cases that ultimately get well. The discharge insinuates itself between the splint and the limb, and, in conjunction with the pressure, causes excoriation, which frequently, in a short time, assumes the form of deep ulcers. These cannot be dressed without raising the limb; and if they are neglected, they become foul, and sometimes sloughing of the integuments takes place to a considerable extent.

Case.

I was requested to see a gentleman at Hampstead, who, ten days previous to my visit, tripped in walking, and falling, produced an oblique compound fracture of the leg, about the middle. The wound was at first small. When I first saw him, the limb was lying upon the outer side upon a splint. On the inner side, the integuments had sloughed, and left a sore from six to eight inches in diameter. In some parts of this sore, the granulations were healthy, but round the opening, leading to the fracture, they had a gangrenous appearance. The convulsive action of the muscles was very strong, and the constitutional symptoms alarming. I assisted in raising the limb so as to see the state of that side which lay upon the splint; and here I beheld a state of parts, which, from such a cause, I trust I never shall see again. Along nearly the whole length of the line of pressure, from a little above the ancle to six or eight inches above the knee, the integuments were sloughing. This gentleman died three days after I first saw him.

Now, reader, picture to yourself a compound fracture of the leg, produced merely by a trip in walking; a compound fracture with a small wound unaccompanied with contusion of the surrounding parts, occurring in a healthy middle-aged man, and enquire in your own mind, whether a person with such a fracture ought not to have recovered under favourable management?

rgeons not
med.

I do not blame the surgeons who had the early management of this case. I know the difficulties which the surgeon has to contend with when this mode of treatment is resorted to. Here the irritation produced in the wound, by the motion of the fractured ends of the bone, was the principal cause of the high inflammation, which destroyed so large a portion of the integuments on the inner side of the leg. The constitution rallied sufficiently to throw off the slough; but a constitution reduced by an effort of this kind is ill able to bear up against increasing mischief. The motions of the broken ends of the bone continued; the granulations which had been thrown out became gangrenous; the integuments on the outer side of the limb were destroyed from the continued pressure of the limb upon the splint, and the irritation of a profuse ichorous discharge. The fever which all this mischief gave rise to was too much for the constitution of even a strong man to con- This gentleman died—died, in my opinion, a sacrifice to this mode of treatment, leaving a wife and young family to lament his premature departure.

Such mischief does not take place in every case.

Do you say "I have seen compound fractured legs thus laid upon the side without being followed by such direful consequences?" So, reader, have I; but before you have seen so much of this practice as I have, you will have seen cases thus aggravated, and followed by similar results.

Now, secondly, observe the consequence of this practice upon the system, when followed for the double purpose I have mentioned.

Constipation of the bowels.

Every surgeon acquainted with his profession is aware that, if men, otherwise in health, have their bowels confined for three or four days, they commonly complain of lassitude, head-ach, thirst, and general uneasiness; that some persons are thrown into a high state of fever by such an occurrence. If this be granted, what must be the effect of constipation in persons who have met with an accident, which always gives rise to fever—in persons who survive the first shock given to the system? Will not that which produces fever when no mechanical injury has been inflicted, increase that fever which necessarily arises from the infliction of such injury? Surely this cannot be denied. If you were called to a patient labouring under inflammatory fever, would you not inquire into the state of the alimentary canal? and if you found that the bowels had not been relieved for three or four days, would you not suspect that such fever was produced by constipation of the bowels, and would you not prescribe some aperient medicines? Certainly, you would do so. But, when you see a compound fracture on the third day, which is then accompanied with inflammatory fever, and you find the bowels constipated, you are told that you must not purge; if you do, you will move the fracture, and give rise to such irritation in the limb as may go on to the destruction of the patient. Conceive now here, what a dilemma the surgeon is placed in. He knows, or he ought to know, that the fever which accompanies local inflammation, contributes greatly to increase it; and that nothing tends more to relieve such fever, where bleeding cannot prudently be resorted to, than aperient medicines. Yet he must suffer the fever to go on, and the inflammation to increase, or run the risk of greater evils from the motion and displacement of the ends of the bone, which would probably be produced by the patient's movements, during the action of aperient medicines. I grant this difficulty. I have seen the effects of purging when the limb is thus placed, and have witnessed with much pain, the effects of fever in these cases, and have anxiously endeavoured to possess myself of means by which these evils could be avoided.

I have now endeavoured to convey my views upon the nature of compound fracture, and its effect upon the constitution. I have mentioned, as far as is necessary for my present purpose, the common modes of treatment, and have pointed out the evils arising from them. I have not, indeed, spoken of all the plans or all the contrivances which are resorted to in the treatment of compound fractures. I have omitted to speak particularly of the fracture-box and of Assilini's trough, but the inadequacy of these to support the fractured parts, I pointed out in a former chapter, when considering the treatment of simple fractures; it will not therefore, be necessary to say any thing further respecting them in this place.

From what has been said, we may infer that compound fractures are really very serious accidents; many of them do well, but many are attended with alarming symptoms, and go on to an unfavourable issue. Perhaps there is no class of injuries which, under the usual management, occasions the surgeon more anxiety; and I know of none, in common life, by which more persons are destroyed.

When I reflect upon these things—when I consider the importance of these accidents, the long period of suffering which many of those who survive their immediate effects have to undergo—when I consider the anxiety of the surgeon in attendance, the anxiety of the patient, and the anxiety of his friends, it gives me great pleasure to find, that I have it in my power to lay before the profession a line of treatment by which these injuries will be robbed of many of their terrors—which will put the limb under the command of the surgical attendant, and enable him to act with confidence, and with satisfaction to himself, to his patient, and to all those whom the result of his treatment more immediately concerns.

SEC. 2.—*Author's Treatment in Compound Fractures.*

When we are called to see a compound fracture, we must consider first, as I have said, whether we can save the limb; and, if after a proper investigation of all the circumstances, we determine to make the trial, our next business is to reduce the bones, under the restrictions and precautions I have mentioned, and then to place the limb upon an apparatus, by which we can secure the fractured ends without impeding the circulation. If the fracture be in the arm, this may be done with a trough, properly constructed for the purpose; if in the thigh, we should use the fracture-bed (*see* page 211), which enables us to fix the pelvis. This is the best adapted for compound fractures of the thigh at any part. If the fracture should be in the leg, the long fracture-apparatus which I employ for simple fractures of the middle and lower thirds of the thigh-bone, and which may be used for simple fractures of the leg, is the best to secure the part in compound fractures of the leg. With this apparatus, we may secure the fracture without difficulty or danger,

Apparatus to be used.

and, instead of obliging us to give such medicines as are calculated to increase the fever, it enables us to administer such as are most calculated to subdue it, and commonly even to prevent the fever from rising to a degree much beyond what is observed in simple fracture.

Compound fractured leg.

I have entered so fully into the manner of treating simple fractures of the leg, where we commonly find compound fracture the most severe, that I have little to say on what may be considered to be the mechanical treatment of compound fractures of this part. There are some points of difference, however, in the treatment to which it is proper that I should advert. I have already stated how the bones are to be supported in simple fractures of the leg, if the fracture be oblique. The mode of supporting them laterally in compound fracture is precisely similar, but the manner of preventing retraction is somewhat different.

Position of the limb.

I always place a compound fracture in the straight position, when I am called to the case in the first instance, or if it has been confined in the straight position for some time before my arrival; and I do so, because I can in this position better answer two indications of immense importance in the treatment of these injuries. I can moderate the flow of blood to the part, and, at the same time, facilitate its return to the centre of the circulating system. I do not mean to undervalue the indication of placing the limb in the bent position. It is well if we can relax the muscles, which tend most to displace the fractured ends, and in some cases this is indispensible, as in some compound fractures of the thigh; but in the leg it is unnecessary. Where we cannot obtain two advantages at the same time, we should endeavour to obtain the greater, which, in my opinion, is the command of the circulation of the limb.

We cannot comfortably place the limb in the bent position, and retain the power over the circulation.

It might be supposed that we can relax the flexor muscles of the limb, and at the same time facilitate the return of the blood to the heart, and impede the arterial action; but if we reflect for a moment, we shall find that this cannot be done with my apparatus, or with any apparatus in existence, when made to extend the limb in the bent position, as in the management of oblique fractures. It will be remembered, that in simple fractures of the two lower-thirds of the femur, the thigh is so placed upon the apparatus, that it cannot be drawn over it by extending the foot; and that, when the leg lies upon the leg-part of the apparatus, if we draw down the foot, we draw down the leg also, till the thigh, resisted in its descent by the thigh-part of the apparatus, prevents the leg from being drawn further down. When we regard the state of the parts so extended, with relation to the apparatus, we perceive that the thigh is made to press upon the thigh-part of the apparatus, particularly at the ham. Here the large vessels of the leg are situated and must be by such extension somewhat compressed. The compression which they suffer I have not found of any importance in oblique simple fractures; but in compound fractures, it should be regarded as an evil which we ought to avoid. If the fracture be transverse, the objection to the bent position does not apply with the same force; but still it must be remembered, that we waive a very important advantage, unless we raise the heel of the apparatus so that the leg-piece shall incline towards the body. If the leg be raised only to a horizontal plane, the return of the blood will be very little affected by it, even if the thigh be much bent upon the pelvis. When we notice the motion of the water of a river, which empties itself over a precipice, we find that the rapidity of its motion is not increased till it comes near the precipice, supposing the decent of the bed of the river to be equal at all parts; but when it has passed the brink of the precipice, its motion increases in velocity in proportion to the height of the precipice. So, when the leg is elevated to a horizontal plane, the blood will pass forward, impelled by the action of the veins, but it will not be assisted in its passage along the tibial veins by its own gravity; but as soon as it has passed the angle at the knee, it will flow more rapidly along the femoral vein, from the cause which impels the water forward with more rapidity after it has passed the brink of the precipice. I do not mean to state that the flow of blood along the veins, and the flow of the water of a river are precisely similar, only in as much as respects the influence of gravity; and here they are governed by the same hydraulic laws. If we raise the limb, so that the leg shall incline towards the body, we facilitate the return of the blood along the veins of the leg in the same way as if the whole limb were inclined upon the apparatus fixed in the straight position. It has, however, appeared to me, that the leg must be raised so much, that it would be uncomfortable to the patient. I have, therefore, even in transverse fractures, which are compound, preferred the straight position.

Mode of applying the apparatus.

When the apparatus is employed for compound fractures, (*Fig.* 1) it is proper to use the brass plate, and to adapt the apparatus to the length of the sound limb. The pad used should be carried over the end of the apparatus, and fastened to the bars on the back of the brass plate, in such a manner as to keep the upper end of the apparatus well covered. The pad should be covered with oiled silk, as high as the knee-joint of the apparatus, or higher, if necessary. The pelvis-strap, *a*, is used in compound fractures, and should always be applied, as it gives the patient the power of steadying the apparatus when he is in the act of raising the pelvis to answer the calls of nature. It assists also in keeping the apparatus close against the back of the thigh, and in preventing it from slipping away from its proper situation. If extension be required, it is made by drawing down the foot, and fixing it as the case may require, while the upper end of the apparatus rests against the tuberosity of the ischium.

Elevation of the apparatus.

The mode of placing and supporting the limb ented in the Fig. The apparatus may

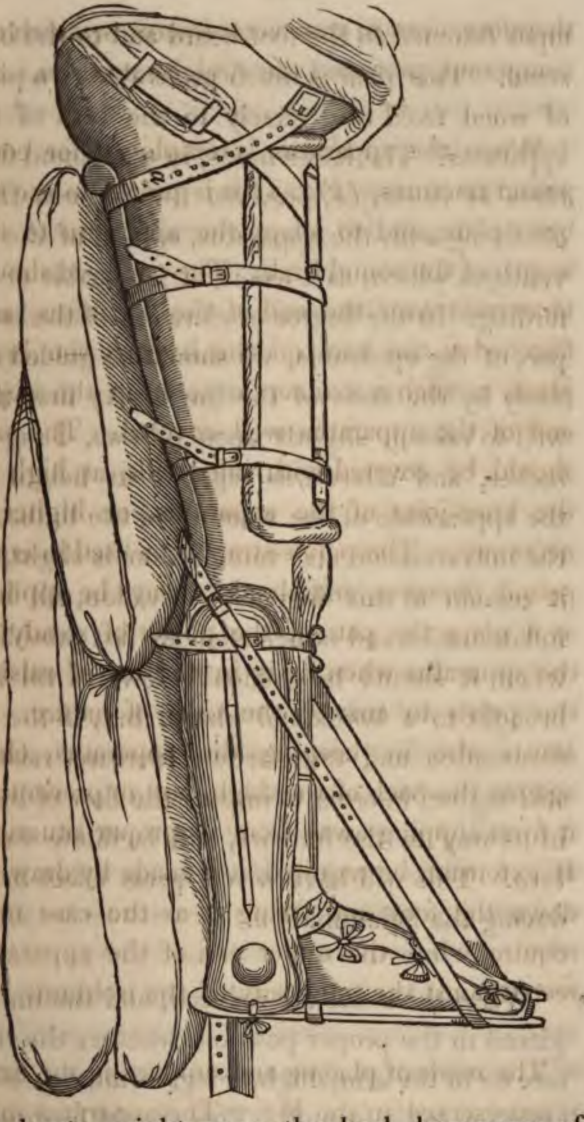


Fig. 1.

be kept upright upon the heel, by means of tapes fastened to the foot-board and to the bedstead. This plan is much preferable to a piece of wood fixed transversely to the heel of the apparatus. The latter mode, in compound fractures as in simple, prevents the surgeon from obtaining with the apparatus, several of the advantages which, as I use it, it is capable of affording. In the degree of elevation of the lower part of the apparatus, we should be guided entirely by the state of the limb. At first it is well to raise it slightly upon pillows, I say six inches, and afterwards regulate its height by the appearance of the wound and the limb. If the inflammation and tumefaction is slight, let it remain at this degree of elevation, till both inflammation and tumefaction are fast subsiding, when it should be gradually lowered till it is brought to a horizontal plane; but, if the inflammation and tumefaction increase, raise it still higher, in order to impede the flow of blood in its way to the fracture, and facilitate its return. This will have a very great effect in reducing the inflammation.

Dressing of the wound.

When the bones are reduced, and the limb is placed in the proper position, whether the fracture be in the arm, thigh, or leg, we must turn our attention to the wound. This should be dressed with great care after it has been cleared of foreign matters and loose detached splinters, which admit of being easily removed. I have seen the wound in compound fracture covered with a pledget of lint diped in blood, in a manner calculated to do great mischief. If we apply a thick piece of lint to the part, and strap it down tight, we are very likely to produce sloughing of the integuments under the lint, where they are pressed against the keen edges of the fractured ends of the bone. We must recollect, that the great objects to be accomplished in dressing the wound, are to approximate the edges of the integuments as nearly as possible, and to exclude the air from the wound.

With lint and plaster.

I endeavour to answer these indications in the following manner. I take some strips of plaster, about half an inch wide, and long enough to extend about an inch and a half beyond the edges of the wound. Upon each of these I place a single layer of lint, a little wider than the plaster, and just long enough to cover the edges of the wound, when the integuments are approximated as near as they can be brought, without any considerable stretching. This lint should be wet with fresh blood. The strips of plaster should be laid upon the wound about a quarter of an inch asunder, and in such a manner, that the lint on one strip of plaster may overlap that on the strip of plaster previously applied, like the tiles of a house, so that the whole of the edges of the wound may be covered by the lint, while at the same time the strips of plaster are placed a quarter of an inch apart. This first part of the dressing has the effect of approximating the edges of the wound, and in a great measure of excluding the external air. But, we wish to prevent the ingress of the air as effectually as possible, consistent with the nature of the case. This is done by layers of lint dipped in fresh blood, and laid over the plaster, so as to cover it completely. Two layers of good lint may be applied in this way, and over these a single layer of dry lint. The last is intended to absorb the serous part of the blood, in order that the lint beneath may be got dry more speedily.

ozing from he wound of lood.

If there be any oozing of blood from the wound after the dressing is applied, which generally happens, it finds its way out beneath the lint in some one part. The blood which issues from the wound separates the lint just sufficient for its escape; and, as the quantity discharged decreases, the passage which it has made, becomes more and more contracted, till at last the blood stops altogether, and closes up the opening through which it issued, by forming a coagulum. The air is thus effectually prevented from passing to the wound during the continuance of such oozing, or after it has ceased, by the channel through which the blood escapes. We should encourage the formation of the clot, by placing a bit of lint over the part from which the blood distills, and after it is once formed, we should be careful not to disturb it, for if we do so, we shall be in danger of laying open the wound to the external air, a circumstance which we have all along been careful to avoid.

Treatment of the parts su rounding the wound.

The next point for our consideration is the treatment of the parts surrounding the wound. Our object is to keep down inflammatory action, so that it shall not run on to gangrene, or even to suppuration, where it can be with propriety prevented. The treatment, so far as it has been described, assists us very materially in the prevention of both these consequences, *viz.* the proper confinement of the fractured ends of the bone, and the exclusion of the external air from the surface of the wound. Compound fractures, as I have stated, are usually attended with a great deal of mischief in the surrounding parts, which gives rise to effusion of blood —to inflammation, and consequent swelling. There is always effusion of blood, and always inflammation varying in degree in different cases, when the patient survives the first shock of the accident. Hence, it is proper in all compound fractures, to make use of such applications as are calculated to check the inflammatory tendency—such as a mixture of acetate of ammonia and water, or spirit of wine and water. Goulard water, with a fifth or sixth part of spirit of wine, form a lotion more beneficial, perhaps, than any other in most cases. I object to white-wash alone, generally, as it greatly tends to lessen the power of the parts to which it is applied. Whatever lotion be employed, care should be taken, that the dressing over the wound be not moistened with it. If the dressing be made wet, the surface of the coagulum of blood in the wound will be destroyed, and you will find that the wound will remain open as far as the lotion has penetrated. From what I have said, you perceive the manner of applying the lotion in these cases, is a matter of considerable importance; and, therefore, requires the surgeon's particular attention.

But, though the surgeon may have been very careful in dressing the wound, suppuration occasionally occurs, in consequence of the severity of the injury, or from the lodgment of some extraneous substance. It might be presumed, that should this be the case in a wound thus sealed up with bloody lint, the matter would be confined, and be productive of extensive mischief; but no apprehension need be entertained from this idea. In every case that I have seen, where suppuration has occurred, the matter has produced a little irritation, which indicates the propriety of removing the lint, or has moistened the lint, and easily effected its escape, without producing any burrowing or other unpleasant symptoms. There will sometimes be observed a small quantity of matter making its way out beneath the dressing, at some particular part; do not let this induce you to remove the dressing, if you find the discharge is unaccompanied with irritation in the wound; for it may be only a little superficial suppuration, which after a few days will cease, and form a scab, under which the wound will cicatrize. If there is no particular irritation, and it appears that the fractured ends of the bone are in proper apposition, I have no wish to remove the first dressing for the first ten days; but about this time it is right to moisten the lint, and remove it; as there is occasionally a little displacement of the fractured ends, which cannot be perceived through the dressing, and which now ought to be corrected. When the wound is suppurating kindly, it might be dressed with any mild ointment, such as spermaceti ointment, which, however, should be changed for any other dressing, as circumstances may direct. Care should be taken to prevent the matter from burrowing, and also to keep the limb clean. The dressing should be applied once or twice a-day, according to the quantity of discharge; and on those occasions, the front and sides of the limb might be completely exposed, by turning back the lateral splints, which might be done without producing the least disturbance of the fracture.

In some instances, portions of integuments and other soft parts are entirely destroyed by the force which occasioned the fracture, or are so injured, that they cannot recover the healthy state. Such parts die and become extraneous, and are, therefore, thrown off in the form of sloughs. The edges of the integuments not unfrequently separate in this way. Sometimes, also, portions of cellular membrane, and occasionally even portions of tendon and muscle; but this is no argument against the adoption of the practice I have mentioned. These parts do not separate commonly till after the lapse of several days; but sooner or later they irritate, so as to produce suppuration. Before suppuration takes place, in consequence of the irritation of such parts, the wound, if it be well protected from the action of the air, will sometimes be nearly filled with granulations, and deep-seated dead parts will come away through fistulous openings, which are usually unaccompanied with much constitutional disturbance.

It now and then happens, in cases where the bone is much shattered, and many of the splinters are denuded of their periosteum and destroyed, some constitutional disturbance will be kept up for months after the injury; but this is nothing in degree compared to what is met with in such cases, when managed in the usual way. Splinters of bone make their way through small openings. Sometimes, a small abscess occurs in their situation, or in the situation of a portion of dead muscle tendon, &c., and such dead parts as have given rise to the suppurative process, are discharged through the opening made to evacuate the matter. Such evils arise only in very bad cases—cases which, in my opinion, would commonly destroy under a different treatment.

Constitutional disturbance.

After the fracture is reduced, the wound dressed, and proper applications made to the limb, there would be but little for the surgeon to do, if the constitution did not become affected; but after all compound fractures, there is more or less constitutional disturbance, varying in degree according to the extent of injury, the age and irritability of the patient. In the more favourable cases, the wound closes by adhesion, or is filled by granulations, which spring up under the first dressing, or during a moderate suppuration. The patient suffers little inconvenience from fever, and the bones become consolidated in eight or ten weeks.

Symptoms vary according to the degree of excitement.

When the constitutional irritation is slight, the pulse is only a little increased in rapidity. When it is a little more, the tongue appears white upon the surface, and is accompanied with a general feeling of uneasiness, especially in the loins and head. When the fever is still higher, the tongue assumes a yellowish cast, the general feeling of uneasiness is increased, and the face is more or less flushed. When in the highest state, the tongue is dry and dark in the centre, as in typhus fever. The pulse is very quick, accompanied with a hectic flush, incoherence of speech, and low muttering delirium. The fever keeps pace with the increase of inflammation in the limb. When the constitutional disturbance is slight, the limb is seldom much inflamed; but, when we have a quick pulse, a dry dark tongue, flushed countenance, incoherent speech, great restlessness, watchfulness, delirium, subsultus tendinum, there is usually a degree of inflammation in the limb bordering upon gangrene. Sometimes gangrene has actually taken place; now and then tetanus comes on, but this is not a frequent result in this country. The functions of the stomach, bowels, liver, and urinary organs, are almost always more or less disturbed, according to the violence of the constitutional symptoms. These are the usual effects of local irritation, varying in different cases, according to the severity of the injury, the irritability of the system, and the powers of restoration.

Treatment in the early stag

I have stated that when persons survive the first shock, some fever always comes on as a necessary consequence of the accident. This is at first of the inflammatory kind; but do not let me mislead you by this term—do not suppose that because the fever is of an inflammatory nature, that we should therefore necessarily draw blood. Let me impress upon my readers, that there are very few cases which require it, and that there are very few persons residing in large towns, who can bear it after severe accidents of this description. But in some few cases, the loss of eight or ten ounces of blood within the first four days may be advantageous; but I have never seen a case in which, in my opinion, it would be proper to draw blood after this period. I have seen bleeding resorted to after the lapse of four days, but cannot assert that I have seen it with advantage; on the contrary, I believe it will be found that such bleedings are generally injurious. They cause great depression, and in some cases death rapidly supervenes.

perients.

There is another mode of relieving the system in the early stage of compound fractures, which is highly beneficial; I mean by the administration of aperient medicines. Do not be alarmed at the mention of aperient medicines in such cases, nor suffer any one to alarm you. A great cry may be raised in some quarters against this practice; but do not regard it. I have already stated, under what circumstances the administration of opening medicines in the early stage of compound fracture has been found injurious. It will be remembered, that the motion and displacement of the fractured ends of the bone produced by the patient in the act of evacuating the bowels, have been found to give rise to so much irritation, that surgeons, employing the common machines or splints, have been for this reason deterred from using medicines of an aperient nature for several days after the accident; but we are now in possession of means by which such motion may be prevented, therefore, we have nothing to fear from the action of aperients under this consideration. The surgeon may confidently expect that with proper management their action will be highly beneficial. I have seen the frequency of the pulse greatly reduced by three or four copious evacuations from the bowels on the third and fourth day. My practice is to procure a copious evacuation or two on the second day, and to cause the bowels to be acted upon rather more freely on the third day. For this purpose, I give such aperients as circumstances may indicate, always taking care to regulate the action of the bowels, according to the particular age and condition of the patient, and the state of the limb. This plan I have found give the patient great relief. Small doses of the citrate of potass should be given every four or six hours, with a view to produce gentle perspiration. The food should be of the mildest kind, and nothing strong should be allowed.

It must be borne in mind, however, that what I have said respecting the use of aperient medicines in the early stage of compound fracture, does not apply to persons far advanced in years without some degree of limitation, nor to very delicate persons, nor to those who are labouring under any debilitating disease of the system. The administration of purgatives is not to be resorted to incautiously. Gentle means should be used in all cases, but more especially in old, weak, and debilitated people. An aperient, strong enough to act upon the bowels, once or twice in the day, is as much as they can well bear. If we reduce such persons by purging, or any other means, they sometimes fall into a state of collapse and die.

Tonic medicines.

When suppuration is established, a more generous diet will be gradually required, and tonic medicines may now be given instead of those which were administered during the existence of active inflammation. These should be regulated with great care, according to the circumstances of the fracture and the particular condition of the system.

I have great reason to feel satisfied with both the local and constitutional treatment which I have ventured to recommend for the inflammatory and suppurative stages of a compound fracture; but I have spoken of a degree of constitutional disturbance which puts on the appearance of low typhus, and is very destructive, being commonly accompanied with gangrene, or with a state of inflammation bordering upon gangrene. This state of the system and of the limb I have noticed for the most part between the sixth and tenth day.

Appearance of the limb in gangrene.

When gangrene takes place, we observe the alarming constitutional symptoms which I have already mentioned. We see the skin of the limb around the wound assume more or less of a livid appearance. In the neighbourhood of the wound, and sometimes for a considerable distance up the limb, the cuticle often separates in parts from the cutis, forming blebs, which contain a bloody serum. The gangrenous inflammation generally extends up the inner side of the limb in the line of the absorbents, presenting to the eye the appearance of brownish red lines. Occasionally I have seen this condition of the soft parts attended with an erythematous blush of the integuments covering the lower part of the abdomen and the nates. Whenever we notice this gangrenous state of the limb accompanied with a typhoid tongue, involuntary action of the muscles, and low delirium, we may expect the worst result. Patients so affected frequently do not recover sufficiently, even to allow of the amputation of the limb.

When there is extreme debility from gangrene, the limb cannot be amputated.

I would here remark, that when the constitution is in this extreme state of debility, and the limb thus affected with gangrenous inflammation, it is in vain to amputate. The constitution cannot bear the loss even of the small quantity of blood which the operation occasions; it therefore has commonly only the effect of hastening the fatal issue. This may be laid down as a general rule. But before the symptoms have arrived to this extreme degree of aggravation, and we have youth and a good constitution on our side, we may amputate, and sometimes, by so doing, we may save the life of the patient, even though the gangrenous inflammation be extending.

Constitutional treatment.

The constitutional treatment, in such cases, consists in supporting the system with wine, sulphate of quinine, and nourishing diet, to be regulated from time to time as the particular condition of the patient may indicate.

Local treatment.

When the wound is sloughy, stimulating applications are commonly the most desirable, even if the limb be not gangrenous. The chlorate of lime or of soda in solution, lowered down with water to suit the state of the parts, are among the best applications to the wound. Sometimes their stimulating properties should be increased by the addition of a caustic alkali. Some of the lotion should be poured into the wound five or six times a day, and lint dipped in it, should be applied wet to the surface. A warm poultice should be laid over the lint every time the wound is dressed. Sometimes, when the limb is becoming gangrenous, a large warm poultice, composed of linseed-meal and strong-beer grounds or porter, placed upon the limb over the lint, is the best application. This should be repeated every four or six hours. If the gangrene be extending from excessive inflammation, a lotion, composed of spirit of wine and water, should l employed around the wound, which should s be covered with the lotion composed of chlorate of lime, and a poultice placed over it. Nothing but general directions can be given for the management of such cases. The accommodation of the remedies to suit the particular condition of the parts must be left to the skill and science of the managing surgeon.

Convulsive action of the muscles.

When the limb is in a high state of inflammation, bordering upon gangrene or actually gangrenous, the convulsive action of the muscles is occasionally very great. We must endeavour to prevent the bones from injuring the soft parts in such cases, if possible, by the means which I have already mentioned—I say, if possible, because in some cases the convulsive action of the muscles is so tremendous, that it cannot be altogether prevented, without that degree of confinement which would interrupt, in some measure, the freedom of the circulation. I have seen the bedstead greatly shaken by the violence of their contraction. When the constitution is in this state, it rarely happens that we can remove the limb—amputation will not save the patient. I have not met with these extreme efforts of the muscles in compound fracture, except in the leg, where the advantages of the long apparatus I have recommended were fully put to the proof, especially in a case accompanied with tetanus. In these cases the action of the apparatus prevents the fractured ends from riding, and only allows them to shake and move a little upon each other; but even this degree of motion cannot take place without irritating the neighbouring tissues, and thereby adding to the evil which previously existed.

Local means.

Under such circumstances we must do the best we can. The best local treatment, in this irritable condition of the parts, is to fill the wound with the extract of opium, softened down to the consistence of cream, and to place over this a large poultice, made of beer-grounds and linseed-meal, which should be changed every four or six hours. I find the opium lessens the convulsive action of the muscles very much, and the beer-grounds poultice is a stimulus often highly beneficial to the parts in this state.

Constitutional means.

Remember in this condition of the constitution and of the limb, we must not purge. We must not even give aperient medicines if the patient has an evacuation once in forty-eight hours; and even when it is necessary to administer an aperient, we must do it with the utmost caution.

ase. I was called to a case of compound fracture on the tenth day, in a gentleman whose limb I found in a very bad state, and the constitutional and local irritation very alarming. When I first saw him, it appeared to me probable that his life might be saved, and I did not altogether give up the idea of saving his limb; as the pulse was not weak, and he was able to take support. Contrary to my expectation, this gentleman, by the advice of his usual medical attendant, took some aperient medicine the same evening, which acted five or six times the next day, and destroyed all my hopes. The action of this medicine so reduced him, that he was no longer able to bear up against the mischief going on in the limb. The limb could not be amputated, and he died shortly after. A patient, so circumstanced, must be supported with quinine and opium, wine, and nourishing diet. *If you purge him you kill him.*

ase. I was called to see a gentleman in the Adelphi, who, eight days previous, in stepping from a boat, fell with such force as to produce a compound fracture of the leg. I found the limb in a high state of inflammation, bordering upon gangrene, accompanied with great debility. He had a dark dry tongue, small quick pulse, and other symptoms indicative of great danger. I placed the limb upon the apparatus, with a piece of oiled silk between it and the pad, and pursued such local and constitutional treatment as the circumstances of the case seemed to indicate; and I had the happiness to find, that this gentleman's dangerous symptoms soon subsided, and he ultimately recovered, with his limb as strong and useful as before.

Uniting process.

The laws which regulate the union in compound fractures, attended with suppuration, are different from those which are observed to obtain in simple fractures. In simple fracture, the osseous matter is deposited, as I have said, upon the surface of the original bone, in some of the coagula, and in the various contiguous textures; but in compound fractures, in which the ends of the bone continue for a considerable time in the midst of surfaces secreting pus, union is effected by a process of granulation. Granulations shoot out from the surfaces of the bone, inosculate with others coming from the opposing surfaces, and in the course of time, becoming dense by the deposition of bony matter, a firm band of union is formed between the fractured ends.

Sometimes much retarded.

The progress of the cure in compound fractures is necessarily regulated by the particular circumstances of every individual case. Sometimes the period of complete restoration is much delayed by exfoliation of small portions of bone, which occasion a protracted suppuration. Occasionally small splinters excite inflammation, which runs on to the formation of abscesses. Whenever this happens, the abscess should be punctured, and the splinter or splinters removed.

Confinement to bed not always necessary during the exfoliating process.

It is not necessary that a patient should be confined to bed during a protracted period of exfoliation. My plan is to bend the knee and support the parts, as for simple fracture, with the exception in some cases of the shin-splint, and allow the patients to leave their bed; and if nothing occurs to prevent, I permit them to move about with crutches, which, with proper caution, may be done with impunity. The period at which a patient may be permitted to use his crutches in compound fractures, accompanied with exfoliation, is uncertain. The surgeon must be regulated in this matter, according to the condition of the parts, and other circumstances which may attend any case of this description which he may be called upon to treat.

Circumstances requiring amputation.

After the surgeon has conducted the case with much skill during its early stages, it occasionally becomes necessary to remove the limb. The particular circumstance which requires amputation is now and then, in young healthy persons, the commencement of gangrene. Ulceration of the main artery of the limb giving rise to mortification, renders amputation necessary. Great exfoliation of bone, producing a large chasm between the upper and lower portions, renders the removal of the limb advisable. Sometimes, also, under common treatment, the suppuration is so profuse, that it becomes necessary to remove the injured parts in order to save the life of the patient. In all these cases, much care is necessary on the part of the surgeon, that he does not come to any rash determination.

SEC. 3.—*Compound Dislocations of the Ancle.*

Nature.

Sir Astley Cooper's account of the nature and local effects of this injury is very good. I shall insert it nearly in his own words:—"These accidents take place in the same directions as the simple dislocations, and the bones and ligaments suffer in the same manner as in those dislocations. The difference, therefore, in these cases is, that the joint is laid open by a wound in the integuments and ligaments opposite to the laceration of the skin, by which the synovia escapes, and through which the end of the bone protrudes; this opening in the integuments is generally occasioned by the bone, but sometimes by the pressure of some uneven surface, on which the limb may have been thrown.

Effects. "The bones being replaced, &c. the effects of this accident upon the parts composing the joint, are as follow:—The synovia escapes through a large wound in the lacerated ligament, and in a few hours inflammation begins; and when an additional quantity of blood is first determined to the part, an abundant secretion issues from this membrane and is discharged through the wound; the ligaments participate in the inflammation, as well as the surfaces of the bones which enter into the composition of the joint. The inflammation of the internal secreting surface of the ligament in about five days proceeds to suppuration. At first but little matter is discharged, but it continues increasing until it becomes very abundant; and the lacerated parts of the ligaments and the periosteum, also secrete matter. Under this process of suppuration, the cartilages become partially or wholly absorbed; but in general only partially, for the ulceration of the cartilage is a very slow process, and attended with severe constitutional irritation, and often lays the foundation of exfoliation of the extremities of the bones. When the cartilages are absorbed, granulations arise from the surfaces of the bones, and from the inner side of the ligament, and these inosculate, and fill the cavity between the extremities of the bones. Sometimes we find, after accidents to joints, that the adhesive process occurs at one part, and that the cartilage is not absorbed, whilst granulations are formed at others, where the cartilage was removed by ulceration; and I have seen, after inflammation in joints, the cartilages remain, and their (opposing) surfaces adhere. Neither does this inosculation of granulations, nor the process of adhesion, lead to permanent anchylosis in every instance; for, if passive motion be begun, as soon as the parts from cessation of pain and inflammation will permit, motion will be in many cases, in a great measure restored, and the other joints of the tarsus acquire such an extent of motion, as to render the deficiency in the mobility of the ancle-joint but little apparent: the aperture in the ligament is filled up by granulations; and, with respect to the extremities of the bone, where they are joined so as to form permanent anchylosis, the union is effected by a deposite of osseous matter in the usual manner in which union takes place in compound fracture.

"Thus then the compound dislocation of the ancle leads to inflammation over a very extensive secreting surface; it produces an extended suppuration over the lining of the joint, which occasions much constitutional derangement; and further, it becomes the source of an ulcerative process, more or less extensive, according to the treatment pursued, by which the cartilages are partly or wholly removed, and by which an irritative fever is supported for a great length of time, and the curative process is sometimes much protracted by disease and exfoliation."

Constitutional disturbance.

The constitutional disturbance which takes place in these cases is of the same description as that which is observed after compound fracture, and requires to be treated in the same way.

The first question which the surgeon has to consider when called to a case of compound dislocation of the ancle is, can the limb be saved? A few years ago the operation of amputation was thought by some of our best surgeons absolutely necessary for the preservation of life, but of late the management of these cases have so much improved, that amputation will not be required in the majority of instances.

Can the limb be saved?

There are certain cases in which it would not be prudent to attempt to preserve the limb in the first instance, and others in which it is proper to amputate after the attempt has been made. The particular circumstances which demand immediate amputation, I shall now briefly enumerate.

In very advanced age, as I have said, persons do not bear well the effects of bad accidents; and, as the irritation arising from amputation is less than that which is produced by a bad compound dislocation, it is much the safest practice to remove the limb. Now and then persons of a great age recover, but the instances are not sufficiently numerous to authorize us to try to save the limb in such cases, unless all the other circumstances are very favourable.

Circumstances requiring amputation.

In some cases, when the wound is very extensive, it is best to remove the limb. When the parts are greatly contused, as by the passage of a heavily-laden waggon over the limb, it is right to remove it at once. Such cases are very different from those which occur from jumping or falling from a considerable height, or from falling in walking or running.

In some cases, when the bones are much shattered, it is better to remove the limb without delay. Now and then the small portions may be taken away, and the limb be preserved. In such cases, it is sometimes advisable to smooth the end of the tibia by the saw, in order that it may rest upon the astragalus so as to form a useful attachment. Occasionally the whole of the bones entering into the composition of the joint are much shattered; when this happens, it is best to amputate immediately.

Dislocations of the tibia outward are attended with more injury to the bones and soft parts, commonly, than dislocations inward, and more frequently require the removal of the injured parts.

The division of the posterior tibial artery accompanying compound dislocation, would render amputation advisable. Sometimes patients recover when the anterior tibial artery is divided, but the division of this artery renders the restoration of the parts less probable, and should be taken into account in coming to a determination as to the propriety of performing the operation of amputation.

When persons, who are labouring under any constitutional disease which has greatly reduced the powers of the system, meet with this accident, the surgeon will in some instances find it the most prudent practice to amputate the limb. This practice will also be found the safest in persons whose constitutions are much injured by free living, &c.

If, after a careful survey of the case, it be deemed proper to attempt to preserve the limb; the surgeon should, with as little delay as possible, bring the parts into their natural situation, and use such means as are calculated to keep them there.

Reduction.

Upon investigating these cases, we sometimes find, though very rarely, that a large artery is divided, and it is surprising that the posterior tibial artery so generally escapes laceration, the anterior tibial being the vessel commonly torn. When the artery is divided, it is necessary to secure it by ligature. The extremity of the bone is then to be washed with warm water, in order to remove any extraneous matter. If the bone be shattered, the finger should be passed into the joint, and the detached pieces removed; but this is to be done in the most gentle manner possible, so as not to occasion unnecessary irritation; and if the wound be so small as to admit the finger with difficulty, and small loose pieces of bone can be felt, the integuments should be divided with a scalpel to allow of such portions being removed without violence. The incision should be so made as to leave the joint with as much covering of integuments as possible. The integuments are sometimes nipped into the joint by the projecting bone, and then the bone cannot be reduced without making an incision to allow of the skin being brought from under the bone: and when the edges of the incised wound are afterwards brought together, we may expect, under ordinary circumstances, that union will be effected. In some cases there is much rigidity of parts, which prevents the base of the tibia from being brought into its natural situation without great violence; when this happens it is advisable to remove a thin slice of the base of the bone, in order to facilitate its reduction.

The mode of reducing a compound dislocation of the ancle is similar to that which I described, when speaking of simple dislocations. (*See* Sec. 4, page 453.)

The constitutional and local treatment required in compound dislocations of the ancle is, for the most part, the same as that recommended in compound fractures of the leg. The long fracture apparatus, which I have had occasion to notice so often, will be found the most advantageous in the management of compound dislocations of the ancle.

I entered so fully into the consideration of the inadequacy of the means commonly made use of to confine the parts in simple dislocations of the ancle and compound fractures of the leg, and the advantages which are gained by the plans of treatment which I have deemed it proper to advise, that I have little to add in this place. I have principally to notice the evils arising from the usual modes of placing the limb in compound dislocations, and to point out how easily these evils may be avoided.

We are told to place the limb on the outer side when the wound is on the inner side, and on the heel, or on the inner side, when the wound is on the outer side; and, if the dislocation be forward, we should place it on the heel. I now wish to draw your attention to the consequences which arise from position merely, as far as respects the recovery of the soft parts when suppuration is established, and the limb with a compound dislocation inward is placed upon the outer side. You will notice that the wound is uppermost, and that therefore the matter has to ascend before it make its escape from the wound. This is the case under common treatment, whether the dislocation be inward or forward; and, if the limb be placed upon the inner side, the same thing must take place when the dislocation is outward. Hence, when suppuration takes place, it happens that the wound commonly remains full of matter, which gravitates towards the under side of the limb; and finding its way among the tendons, running from cell to cell in the cellular texture, which, in the majority of these cases, at the expiration of a fortnight or three weeks, has usually become very loose, it collects in remote parts of the limb, and there, becoming putrid and irritating, produces abscesses, which burst in different directions, sometimes at the calf, sometimes at the knee, sometimes in the line of the fibula, &c. These collections of matter repeatedly form, and almost as constantly make their way to the surface, giving the patient great pain, and the surgeon much anxiety and trouble; nay, further, I have seen these abscesses so large, and the discharge from them so great, that the patient has been obliged at last to submit to amputation, in order to save himself from an untimely grave. All this arises, for the most part, from the lodgement of the pus in the wound; it is, therefore, a matter of some importance to place the limb in such a position, that the pus may have a ready exit. But, if the wound is on the outer side, we cannot lay the limb on that side, for if we do so, how are we to dress the wound. This could not be done without raising the limb; and by so doing, we should move the parts, and produce more mischief than would probably arise from the retention of the pus; of two evils, therefore, it would be right to choose the least.

In compound dislocations outward and inward, my plan is to place the limb upon the heel, in the same manner as for compound fracture; and by so doing, I avoid the evil which arises from the retention of pus. When suppuration is established, the matter readily escapes, and we can dress the wound without difficulty, and without any danger of moving the leg or foot.

I have never yet met with a compound dislocation of the ancle forward. If I should be called to such an accident, I should regulate the position of the limb according to the situation and state of the wound. In the first place, if the injury were recent, I should place the limb confined in my apparatus, on the heel; but, if suppuration should come on, I should turn it round, so that the matter may flow freely from the wound. Of course, care should be taken in compound dislocations, not to allow the pus to flow into the shoe of the apparatus; which may be easily done, by the application of a bit of lint for this purpose. In these cases the apparatus has the same power over the limb as in compound fracture, preventing motion and displacement.

I need scarcely observe that, in the treatment of compound dislocation, the wound is to be managed in the same way as in compound fractures, the applications being regulated according to the particular condition of the parts.

Amputation sometimes necessary.

I may remark here, that, after an attempt has been made to save the limb, it sometimes becomes advisable to amputate. The operation in compound dislocations of the ancle, as in compound fractures, becomes expedient, sometimes from the occurrence of gangrene, sometimes from extensive exfoliation of bone, and sometimes from profuse suppuration.

In concluding this section I may observe, that such is the power which the apparatus gives the surgeon over the fractured parts, both in compound fracture of the leg, and in compound dislocation of the ancle, that he has them completely under his control. He can prevent retraction—he can prevent lateral displacement—he can prevent the motion of the fractured extremities, which is occasioned by the motion of the body, or the passive motion of the limb, whether such motion be intentional or accidental. He can dress the wound in a compound fracture and in a compound dislocation, without disturbing the injured parts. He can apply any kind of dressing to the wound, and keep the limb clean. During the suppurative stage of a compound fracture, or a compound dislocation, he can place the limb so that the matter might escape as rapidly as it is secreted. The apparatus too enables us to have the patient's bed-linen changed, and even to have his bed made as often as may be necessary for his comforts, without disturbing the fractured parts. These are advantages, which may be duly appreciated by the profession, when they are rightly understood; they are such as will be found to contribute very materially to the comforts of the patient during his confinement, and to the preservation of many limbs and lives.

CHAP. XV.

FRACTURES OF LONG STANDING.

SEC. 1.—*The Causes and Nature of Fractures of Long Standing.*

Usual significa tion of the terr non-union or dis-union.

BY the term non-union or dis-union, surgeons signify a fracture which has remained disunited a longer time than fractures in a similar situation, and at the same period of life, usually take in becoming united. In a more confined sense, however, these terms signify fractures which cannot be made to unite by the usual modes of treating recent fractures.

Observations upon these terms.

These terms do not express the state of the fractures which they are used to designate. They express, merely, that the bones are not united without any reference to the time which the fracture has existed; they are, therefore, equally applicable to fractures in a recent state and to those of long standing. It does not appear that we have any word which conveys to the mind, correctly, that particular condition of a fracture which surgeons have attempted to express by the compound appellation, non-union or dis-union. It seems to me, that what we wish to convey, cannot be properly designated by any term which has not, at the same time, reference to the fracture and the length of time that it has existed. I shall not attempt to supply this deficiency; and, therefore, when I make use of either of these terms, I shall employ it in its most general acceptation, to signify a fracture which, from some cause or other, has continued dis-united beyond the usual period.

Bones endowed with reparative powers.

Experience has taught us, that the bones, as well as the softer textures, are endowed with vital powers, by the operation of which, injuries inflicted upon them are repaired. If any breach of continuity is accidentally made in the osseous structure, that breach is soon closed; and the bone becomes again converted into one solid mass. But, it should be remembered, that the bones, like the skin, nerves, blood-vessels, &c. require a period peculiar to themselves for the reparation of injuries. This period varies in different animals, and at different periods of life. The restorative process is, also, retarded or facilitated, according to the particular state of the constitution of the individual, the vital condition of the parts, the treatment adopted, &c. Thus we see that the process of union in bone is influenced by all those causes which effect the healing of the soft parts. In man, if the constitution and the bone are healthy, and proper assistance be given by art, the process of reunion almost always goes on progressively to its completion; but, if this process has been disturbed by any cause, it often becomes slow and tedious; and, in some cases, no osseous union has ever been produced.

When non-union occurs.

Fractures of long standing are met with at all periods of life, and are by no means uncommon.

Causes of non-union.

The causes of non-union might be said to be either constitutional, constitutional and local, or purely local.

Constitutional.

Among the first we may consider fevers, scurvy, &c.; also, some organic diseases, as phthisis, dysentery, &c. which occasion great disturbance in the system; likewise, constitutional debility, which might be hereditary, as scrophula, &c. or acquired, as that enfeebled state, which is often produced by habitual debauchery, old age, &c.

Constitutional and local.

In the second class of causes we must rank pregnancy. In pregnancy there is frequently much disturbance of the whole system; and, though this might not amount to disease, it might be sufficient to influence the union of a fracture. Add to this the restless feeling of some women in a state of pregnancy, which, under the use of means so little calculated to secure a fractured bone, as those usually employed, must frequently be productive of motion of the broken ends of the bone; which, as I shall presently attempt to show, contributes, in no inconsiderable degree, to the formation of preternatural joints. Thus we see, that constitutional and local causes might operate in retarding, and might even prevent, the process of union from being accomplished during the latter months of pregnancy; though there be no disorder in the system, further than this state commonly gives rise to. According to my experience, however, fractures of long standing do not occur more frequently in pregnant women than in others. I have seen about ninety cases of non-union, but have not yet met with more than two which happened during the process of gestation. I should, therefore, be disposed to attribute non-union, in persons so circumstanced, more to the inadequacy of the usual modes of treatment, than to the peculiar disturbance of the system which is observed in pregnancy.

Local causes.

The causes of non-union which might be considered purely local are also various.

Disease in the bone.

Disease in the bone sometimes prevents a fracture from uniting. A short time since, I saw a man who had necrosis in the humerus, in which there was a fracture. No union took place, and the man's arm was amputated. I, also, saw a young girl who had a fracture in the humerus, occasioned by an abscess in the bone. In this case, I am informed, no union took place.

Want of apposition.

Want of apposition, from the interposition of a foreign body, as a portion of the clothes, a bullet, a piece of dead bone, &c. between the fractured surfaces, is a cause of non-union. A portion of muscle, which, though not deprived of vitality, might keep the fractured ends from coming into contact, and thus, prevent the union from taking place by the intervention of callus.

Diminished action.

Diminished action in the fractured part, from too long a continuance in the use of sedative or cooling lotions, is a frequent cause of tardy union. Such lotions should never be applied longer than is required to subdue the active inflammation. If they are continued longer than is sufficient for this purpose, they invariably retard the union, and sometimes prevent it altogether.

Want of rest.

But, by far the most frequent cause of non-union that I have noticed, is want of rest, in consequence of the inadequacy of the plans of treatment which have been employed. I consider this to have been the primary cause in almost all the cases I have examined.

Insufficiency of the usual modes of treating recent fractures.

I have above explained the imperfections of the common contrivances, and entered into the particular causes which give rise to the various evils which take place under their employment. I have stated, my belief that, in consequence of the demonstrable imperfections with which they abound, loss of limbs and lives are very numerous. I should say that the cause of death, in nine cases out of ten, resulting after compound fractures and compound dislocations might be fairly attributed to the inadequacy of the mechanical treatment. To the same cause we must ascribe, also, the frequent occurrence of deformity after fractures, whether simple or compound. Except in those attended with great comminution of bone or exfoliation, a degree of deformity which is deserving of notice ought not to occur. Surgeons must no longer attribute the production of deformity to the involuntary action of the muscles. This cloak for ignorance is now grown thin, and will not skreen its wearer. The muscles act, indeed, involuntarily, so as to displace the broken bones under the usual treatment—but why? Because the injured limb is not properly supported—because the fractured ends of the bone are suffered to prick and lacerate their substance. When the broken portions of a bone are kept in proper apposition and at rest, the muscles are not irritated by them; nor is their tonic contraction any thing more than what is readily overcome and resisted, whatever might be the situation of the fracture. To this I know scarcely an exception. Some narrow-minded men in the profession, who are wedded to old plans and practices, or jealous of the introduction of new, will conceive it their interest to oppose this doctrine; while such men live, the weakest measures will not want advocates.

With persons of this description it will be in vain to argue. I expect to be opposed here; but, though I am open to honorable discussion, I rest secure from the shafts of petty bickerers. I feel myself standing upon the rock of truth, supported by extensive experience; and I, therefore, fearlessly inform the sceptical, that great deformity, except in the instances I have mentioned, is the result of bad treatment; and, whether the fracture be in any of the long bones of the upper or lower extremity, might be easily prevented where osseous union can be brought about; and the patient's mind and body are in a state to second the views of the surgeon.

An imaginary cause of non-union.

To return—it is considered that some peculiar state of the constitution is a frequent cause of non-union in persons apparently healthy—that there exists some latent disease or disorder which evades our senses, but whose operation is sufficiently powerful to prevent the union of bone by the interposition of osseous matter. I am inclined to believe, however, that such a state of the system but seldom, if ever exists. This is one way of solving the question—a way, indeed, to which we are all too prone to resort, neet with a difficulty that does not adily explained.

Signs of a healthy constitution.

How do we judge of the vigour of a constitution? I should say by the general appearance of the patient; by his own account of his general health; and by the power which the constitution evinces of resisting the influence of disease or accident. If a patient looks well; is able to bear much exertion without fatigue; if he rises refreshed, has a good pulse, enjoys his food, and tells us that he hardly ever experienced disease, with the exception of a slight cold occasionally, or now and then a little feeling of dyspepsia: if, in his account of himself, he assures us that, whenever he has met with a slight accident, such as a flesh-wound or bruise, he never had any trouble to restore the injured part; that he has always found flesh-wounds heal speedily; that, after the fracture, for which he may be consulting his surgeon, he suffered but little pain; that he had but little tumefaction, or, if he had, either or both of these from the severity of the injury, when the bones were placed in their proper situation they very soon subsided—should we, I say, after a detail of such facts, well authenticated, pronounce that the want of union in his bone arose from weakness in the constitution—some hidden disease lurking there or in the part? Surely it would not be philosophical to do so; yet it is in such persons that cases of non-union most frequently occur. One can, therefore, scarcely help perceiving the inconsistency of this opinion.

Non-union occurs most frequently in very healthy persons.

I have examined now about ninety cases of non-union, exclusively of those which I have witnessed in the neck of the thigh-bone, olecranon, and patella. The constitutions of three of the persons in whom these cases occurred were decidedly bad; another had been much reduced by cholera during the recent state of the fracture. The remaining number, apparently, possessed constitutions and enjoyed health equal to the most vigorous and healthy individuals that come under our observation. I cannot bring myself to believe that there was, in any of these persons, some peculiar weakness, or that they had any hidden disease in their systems which prevented their bones from uniting. In these cases, with the exception of two which occurred during pregnancy, where constitutional causes might, under any treatment, have operated in a measure so as to retard the union, I think the cause was purely local; and, for the most part, if the treatment had been such as to secure the fractured parts in proper apposition, and in a state of quietude, the fractures would have united at an early period.

Here a question might be started. According to the view which you take of this subject, persons who possess the strongest constitutions are the most subject to fractures of long standing; and that the principal cause of their occurring in such persons, is the frequent disturbance of the fractured ends, in consequence of the insufficient support afforded to them by the contrivances now commonly recommended?—Granted. How comes it, then, that the bones of all the lower animals, whose restorative powers are universally allowed to be greater than those of civilized man, should be found with their bones generally united after fracture; and that, too, sometimes with the fractured surfaces separated considerably asunder? Question.

I apprehend thus:—When any of the lower animals, in a wild state, have their limbs broken, there is great inflammation set up in the part, from the friction of the broken extremities upon one another; and, mark—not only upon one another, but, also, upon the surrounding parts, pricking and lacerating muscles, tendons, nerves, arteries, or any thing else that may happen to be within their reach. This pricking and tearing is not once only, but whenever the animal moves, till the contiguous textures become dense, in Answer.

consequence of the large quantity of adhesive matter thrown out to defend them. The inflammation is thus kept up for a long but indefinite period. This continued excitement occasions a large quantity of callus to be thrown out. The broken ends of the bone continue to ride in this as long as it remains soft, and, as the bony matter is deposited, they become fixed in that situation where they may be accidentally placed. Sometimes this is at a considerable distance from one another. When the callus is ossified, all that part of it is absorbed, which is more than sufficient to give the bone a proper degree of strength, in order to support the body, or to bear any of the natural actions of the muscles; and if the ends of the bone happen to be separated much, they then appear to have been united by a bar of bony matter shooting from one to the other, *(see Plate* VI. *Fig.* 1). But, in fact, this bar of bone is nothing more than what remains of the callus which was thrown out in the first instance, as I have said, in a very large quantity.

Comparative power of man and the lower animals—how discovered.

In order to discover the comparative reparative powers of man and the lower animals, and to see how far they resemble each other in this respect, it is necessary to place the parts, as nearly as possible, in similar states; always bearing in mind, that in man there is much greater excitability than in the lower animals. When a man breaks his limb, the restorative process is assisted by art, with a view to prevent the limb from becoming deformed, and, at the same time, to preserve the patient from the pain which the broken ends of the bone would occasion by pricking and tearing the soft parts; but no such care is taken of the lower animals in a state of nature. If a man breaks his leg, surgery dictates that he should have splints applied to prevent the bones from moving; but, I have already stated, that those commonly resorted to have not this effect in many instances. The displacement, however, and consequent injury which takes place, are much less than they would be were no splints employed; and, in some fractures, no injury of consequence is produced in the surrounding parts from the broken ends of the bone; but there are very few in which the fractured ends do not move more or less.

The probable effect of partly restraining the motions of fractured bones in the latter.

Now, if a fracture in any of the lower animals were supported so as to prevent the broken extremities from tearing the surrounding parts, in the manner I have described, but, at the same time, not so as to prevent them from rubbing upon each other, I suspect there would be very little inflammation set up; perhaps in many cases, not sufficient to give rise to osseous union; and there would, consequently, be merely an effusion of ligamentous matter, which might ultimately form a preternatural joint.*

In order, therefore, to see whether similar states would be followed by similar results in man and the lower animals, it is necessary to prevent, in the latter, the great irritation which is commonly kept up by the broken ends of the bones. This might be done by confining the limb in such a way as would allow of but little motion in the fracture when the animal moves the limb. Slight motion, however, should be allowed at the same time that the soft parts are guarded from the injury which the fractured ends of the bone would inflict upon them, were they not at all supported.

Such are the notions which I have been led to entertain upon the causes which give rise to fractures of long standing.

---

* I have met with several false joints in the lower animals. In these instances union had taken place by ligament, as in man.

State of fractures of long standing.

When fractures in this state are examined, the ends of the bone are sometimes found connected together by a structure resembling ligament; sometimes by a ligamento-cartilaginous structure; occasionally the fractured ends are enlarged from a deposition of bone around their edges, and are connected together by a preternatural capsule, *(see Plate* VI. *Fig.* 2,*)* containing a fluid which much resembles synovia. This fluid lubricates the opposing surfaces, so that they move freely upon each other. In such cases, the functions of a joint are performed between the fractured ends of the bone; and the patient experiences no inconvenience, except from the loss of power in the limb.

Sec. 2.—*The usual Modes of Treating Fractures of Long Standing; with Cases and Observations.*

Had surgeons in general attended sufficiently to the causes which prevent fractured bones from uniting, while the fracture is in what might be called its recent state, we might have expected that these cases would be now far less frequent than they are. A great deal has been said as to the treatment of fractures of long standing; but, as far as I know, we have hitherto been furnished with but little as to the mode of preventing their occurrence. The principal differences which obtain in these cases have been described, but no corresponding attempt has been made to suit the treatment to the particular condition of the injured parts. What has been said upon non-union seems to be a chaos of facts; and, hence, we find, that the plans of treatment that have been recommended are still generally resorted to in the most indiscriminate manner, according to the particular fancy of the surgeon.

Rarely successful.

The modes of treatment that have been employed in these important cases are many. These differ from one another in some particulars, but they have all been, for the most part, very unsuccessful; so much so, indeed, that I think I shall be far within the mark when I say, that not one in twenty in which they are tried is followed by a favourable result.

The object proposed.

The object, in almost all the plans that have been advised, has been to re-produce inflammation in the seat of injury; either of the adhesive or suppurative kind. In doing this, surgeons endeavour to place the fracture in a state somewhat similar to that which existed immediately subsequent to the accident. In this respect they have had science to guide them ; for, in all cases of fracture where the process of union goes on uninterruptedly, one of the first changes which takes place after the accident is an inflammation of the soft parts adjacent to the broken extremities of the bone. When, therefore, the action in the part is not sufficiently high, it has been found that, by increasing the inflammation or re-producing it, if it should have altogether subsided, osseous union of the broken extremities has been sometimes accomplished.

Blisters. Blisters applied over the fracture have been occasionally found useful in accelerating the process of union, when it has been proceeding slowly. This mode seems to produce its beneficial effects by exciting the action of the parts immediately contiguous to the fractured ends ; therefore we cannot expect it to be serviceable when the bone is surrounded by a considerable quantity of muscle, as the humerus or femur. When the fracture is in the tibia, the inflammatory action might be communicated from the skin to the periosteum, and thus facilitate the cure ; but even here it frequently fails to be of any service.

iction.

Another plan is, to rub the ends of the bone forcibly together. The friction has been produced either by grasping the two ends of the bone, and rubbing them upon one another; or by making the patient bear upon the injured limb, in the act of walking, after it has been firmly enveloped in splints. This plan has also been now and then followed by union of the bone.

ase.

I recollect, at an early part of my studentship, at the Borough Hospitals, I saw a man at Guy's, who had a fracture of the tibia, which was tardy in uniting. He had a leather case, similar to that invented by Dr. Inglis, of the Royal Infirmary, Edinburgh, confined round the limb, from the ancle to the knee; and was directed to walk about with it, buckled as tight as he could bear it. The fracture, in this instance, united in the course of a few weeks.

he effect of a ruise, &c.

A bruise or laceration of the part contiguous to the fracture will sometimes have the same effect.

Case.

A gentleman had a fracture in the thigh, in which no union could be produced. Several months after the accident he was thrown out of his gig, and the wheel passed over the limb at the fractured part. He was confined after the second accident, which was followed by high inflammation; and now the fractured bone united.

These modes commonly of little use.

These cases show the advantage which may be gained by exciting inflammatory action in the part when the fracture has existed a considerable period; but this alone rarely succeeds in bringing about consolidation of the bone.

Case.

Some time ago, I saw a lady who had a fracture of the tibia at the small of the leg. This lady had had blisters tried for a long time, and had been bearing upon the limb, in the act of walking, for a twelvemonth when I saw her, with the leg tightly bound up; but neither of these plans proved beneficial.

Remarks.

I have seen many instances where these means have been tried without effect. They produce, however, adhesive inflammation, often followed by the deposition of a large quantity of coagulable lymph, which is sometimes mistaken for callus.

Rasping the ends of the bone.

When the fractured ends of the bone are cut down upon and denuded by rasping off the adventitious coverings, inflammation of the suppurative kind is commonly occasioned. Sometimes, however, the irritation produced by this operation is followed by gangrene, so extensive as to destroy the patient in a very few days after it is performed.

Removing them.

Another operation, performed with a view to cure fractures of long standing, is the complete removal of the fractured ends of the bone by the saw, after they have been thoroughly exposed and separated from the surrounding soft parts. This is a very severe operation, and by no means unattended with danger.

Results favourable.

Mr. C. White, of Manchester, who, I believe, was the proposer of this operation, succeeded in producing union in the large bone of the leg after performing it. The union was effected in twelve weeks. He succeeded, also, in bringing about consolidation of the bone in a boy whose arm had remained disunited for six months, by the same plan.

Result favourable.

Dr. Inglis, of Edinburgh, produced osseous union, in the tibia, after nine months had elapsed from the period of the accident, having taken away a portion of the upper part of the bone, by means of a trephine and saw. The bone, in this case, united in about ten weeks.

Remark.

But the cases of failure after this operation are very numerous.

Case.

Mr. G. Rowlands, senior surgeon to the Chester Infirmary, performed this operation (in 1806) in a case of fractured thigh. The fracture was situated in the middle of the thigh, and was produced by a blow. Upwards of five months after the accident, when Mr. R. performed the operation, the injured limb was about four inches shorter than the other, and was perfectly useless. Mr. R. made two incisions, one between the vastus externus and the rectus, and the other across the vastus externus, of sufficient length to expose the ends of the bone, which he found separated considerably from each other, by the interposition of muscular fibre. After much difficulty, he succeeded in sawing off the ends of the bone with a common amputating saw; and the patient ultimately, though not till the expiration of many months, recovered sufficiently to be able to walk with a stick and a high-heeled shoe.

Observations.

Mr. R. concludes his observations upon this operation, in the following terms. "Though I have several times performed all the principal operations that occur in surgery, and very often many of them, I confess, this far surpassed any thing I had ever undertaken or witnessed; and I am doubtful as to the propriety of recommending it to be done by others." *

Boyer's opinion of this operation.

Speaking of sawing off the ends of the bone in cases of non-union, M. Boyer observes, that it is an operation painful, bloody, and of uncertain success.

Dr. Physic's opinion.

Dr. Physic, an eminent surgeon of Philadelphia, mentions that, when a student, he saw this operation performed in the arm; but he states that no benefit was derived from it; and some months afterwards, the arm was amputated. This case, says the Doctor, made a strong impression upon my mind, and rendered me unwilling to perform a similar operation.

The author's opinion.

I have seen this operation performed twice; and I can bear testimony, with these gentlemen,

---

* Medico-Chirurgical Transactions.

as to its great severity. Both the cases to which I allude were in the humerus.

The difficulty and pain experienced in two cases, with remarks.

The general rule in performing this operation, is to make an incision down upon the ends of the bone, in that situation where they lie nearest the surface; and in such a manner as to avoid wounding important parts. The place chosen in the cases to which I allude, was on the outer side of the arm, between the triceps and biceps. The broken ends of the bone having been exposed, the limb was bent, so as to make them project towards the wound. The soft parts were then dissected back from the ends of the bone. This part of the operation was very painful, and was accomplished with great difficulty, in consequence of the convulsive action of the muscles, which was very powerful, and disturbed the ends of the bone at every stroke of the operator's knife. The next step was scarcely less difficult or less severe—that of sawing off the ends of the bone. The muscles continued to act convulsively, the nerves were stretched, and the cries of the patients were exceedingly distressing. Now, what was the result of all this difficulty—of all this pain—what is the common result? To say the best of it, a long confinement in bed, with a large suppurating wound, frequently accompanied with exfoliation of the sawn extremities of the bone. After submitting to this operation—to this pain—to this confinement—after endangering his life, it is more than probable that the patient will be burthened with a limb more useless than before.

First case—
result bad.

The subject of one of the operations to which I have alluded, was a man possessing a strong constitution. After many months' confinement in bed, during which, portions of bone came away, he was allowed to get up. I saw this man about eighteen months after the operation; the wound had then healed, but the arm was much worse than before it was performed.

Second case—
result bad.

In the second case, the fracture was oblique, and about half an inch of each of the fractured ends was taken away, in order to obtain as large a surface as possible for the adaptation of the denuded ends. After many months of suffering from exfoliation and abscesses, this man left his bed, with the limb much worse than before. Before the operation, he was able to write, to tie his shoes, and to perform various little offices with the hand; but so great was the injury done to the nerves, that the hand and arm are now perfectly useless.

This operation is sometimes fatal.

Seton.

I have to mention a mode of treatment more recently recommended—I mean the introduction of a seton between the ends of the bone. This, I believe, was first employed by Dr. Physic, of Philadelphia. The object of the seton is the same as that proposed by rasping the fractured ends, sawing them off, and rubbing them with caustic; *viz.* to produce an inflammation in the part of the suppurative kind.

Case.

Dr. Physic has given, in the New York Medical Repository for 1804, a detailed account of a fracture of the humerus, which had existed twenty months, for the cure of which, he introduced a seton, and ultimately succeeded in obtaining consolidation of the bone.

The operation was performed on the 18th of December, 1802, twenty months after the accident happened. The patient was a seaman, twenty-eight years of age, and the fracture was situated about two inches above the elbow, and was occasioned by a heavy sea as it broke over the ship. No swelling of consequence supervened, nor did he suffer "any pain." Nineteen weeks after the accident, he felt he had gained some strength in the arm, and conceiving it united, he went on board ship again, in the capacity of steward. He was here under the necessity of using his arm; and he found, that it got gradually looser and looser, till a complete preternatural joint was formed. The seton which Dr. Physic introduced, was kept in till the 4th of May, 1803, not quite *five months*. The arm was at this time so strong, that he was able to move the limb in various directions. The seton was now removed. On the 28th of May, being a period of upwards of five months from the time the operation was performed, the consolidation of the bone was considered perfect, and the man was discharged from the hospital.

Dr. Physic states, in his account of this case, that the inflammation produced by the seton was not more than is usual when the seton is placed in the soft parts for any other purpose.

Mr. Brodie mentions a case which occurred in St. George's Hospital, for the cure of which a seton was successfully employed.

A boy, between twelve and thirteen years of age, had both his thighs fractured by the wheel of a waggon as it passed over them. The left thigh was fractured in two places; and, in this, union took place at the end of the usual period. The right femur was fractured through the middle in one place. This limb was supported by splints in the usual way, but the fractured ends did not unite. Case.

The accident happened on the 30th of December, 1812; and, on the 14th of June, 1813, upwards of five months after the accident, Mr. B. introduced a seton between the ends of the bone. The needle met with so little resistance in its passage through the limb, that Mr. B. was led to conclude, there was no union, even by soft substance, but that there was a complete preternatural joint.

No considerable inflammation immediately followed the introduction of the seton. The boy was kept in bed ten days, when a splint was applied on each side of the limb, and he began to walk with the assistance of crutches. At the end of a month from the time of the operation, a good deal of soft union had taken place. On the 2d of August, the union was considered more complete, and he was desired to leave off the splints, On the 10th of August, he was able to walk with one crutch, and to press with considerable weight on the foot of that side. On the 30th of August, an attack of erysipelas took place, which began at the wound made by the seton, and extended over a great part of the limb. The seton was withdrawn, and he was now again confined to his bed. The erysipelas subsided, but left him much debilitated; so that he made no more attempts to walk while he remained in the hospital. On the 20th of September, being upwards of three months after the introduction of the seton, he returned into the country for the recovery of his health. The broken ends of the bone were now so far united, that only slight motion could be perceived in the situation of the fracture, as if, says Mr. B. the uniting substance was not completely ossified.

This boy's limb afterwards united firmly. No motion could be discovered in the fracture twelve months after the introduction of the seton.*

Remarks.

Here it will be observed, that upwards of five months had elapsed before the operation was performed. The boy remained in the hospital upwards of three months, after the introduction of the seton, from the 14th of June to the 20th of September. He suffered greatly from the introduction of the seton and the movements of the limb; and when he was discharged, motion could be felt in the fractured part.

---

* Medico-Chirurgical Transactions, vol. v.

Case. A case was communicated to the Medico-Chirurgical Society by Mr. Brodie, which occurred in the practice of Mr. Josias Stansfield, in the Leeds Infirmary, where the result was favourable. The fracture, in this case, was in the humerus, and had existed upwards of six months. Union was accomplished in two months, during which, the man, who was forty-eight years of age, wore the seton. The attack of fever, which came on in consequence of the seton, was severe, and the pain experienced very great.

Case. Mr. Brodie mentioned to me another case which occurred in his own practice, where the seton produced a cure. The fracture was in the clavicle.

Case. Mr. Wardrop relates a case of fracture of the thigh, about four inches below the trochanter major, for the cure of which he employed a seton. The fracture was transverse, and had existed twenty months. The gentleman was confined upwards of three months after the accident, and then suffered to move about with the assistance of crutches.

Considerable hæmorrhage followed the introduction of the seton, which Mr. W. had some difficulty in stopping. In eight days after the operation, suppuration was completely established, and the swelling around the wound began to subside; and, at the same time, the accompanying febrile symptoms, which had been pretty severe, became more moderate.

On the evening of the tenth day after the operation, the gentleman had a feeling of distention round the wound; and, on examining the limb some hours afterwards, a considerable quantity of blood was found to have escaped, both from the upper and lower openings. When the dressings were removed, the hæmorrhage appeared to have ceased; but there was a great deal of tumefaction of the soft parts, contiguous to the upper wound, which created much uneasiness.

The bleeding did not return, but the patient's mind continued in a state of great alarm, and he suffered much from the distention occasioned by the extravasated blood and the pain in the wound. The discharge, too, became profuse. A considerable degree of erysipelatous inflammation attacked the skin of the upper and posterior parts of the limb, and he had a great deal of symptomatic fever, with a weak, irritable, and very frequent pulse.

The seton was withdrawn on the 21st day, the constitutional irritation being extremely severe.*

Remarks.

All the benefit which this gentleman derived from this operation, the effects of which, it appears, nearly cost him his life, after about *nine months* confinement in bed, was the power of moving the limb, somewhat backward and forward, and from side to side, which he was not previously able to do.

Case.

In the case of non-union in the humerus, mentioned by Mr. Earle, the seton was introduced about nine months after the accident. It produced great irritation and constitutional disturbance. Mr. Earle states that, though great care was taken to keep the bones together, no good resulted from the use of the seton, and at the end of the seventh week it was withdrawn.

---

* Medico-Chirurgical Transactions, vol. v.

Results in three cases.

I have seen three cases of non-union treated with setons—one in the femur, and two in the humerus. The constitutional disturbance produced by the seton in the thigh was extremely severe; but the irritative fever, occasioned by it in the other two instances, was not great. Not the least benefit was obtained from its employment in either case.

Remarks.

Such have been the general results following the introduction of the seton in this country—its employment very rarely produces consolidation of the bone. It must be admitted, however, that the introduction of the seton is an operation much more easily performed, and much less painful to the patient, than that of cutting down upon the ends of the bone, turning them out, and removing them, or the adventitious deposite by which they may happen to be covered; yet its after consequences are sometimes much more severe than those which follow excision of the fractured ends, or rubbing them with caustic. In one of Mr. Earle's cases both these operations were performed. Finding the seton unavailing, Mr. E. cut down upon the fractured ends of the bone, and removed the soft parts which held them together, and afterwards rubbed them with caustic till they became black, but no permanent good was obtained.

SEC. 2.—*The Plans of Treatment which the Author has found most successful; with Cases and Observations.*

Having made up my mind upon the treatment of recent fractures, I began to turn my attention to the consideration of those of long standing, which resist the usual means of cure. I had arrived at modes of treatment by which these cases might usually be prevented ; my next business was, to find out some way of curing such as may be already in existence ; and such as might occur in situations where proper surgical assistance could not be procured during the recent state of the fracture.

I have stated that the contrivances commonly used to preserve apposition and rest are not to

Contrivances usually employed not to

be depended upon.

be depended upon; that they are scarcely safely used in the most simple kinds of simple fractures; and that, when the fracture is attended with laceration of the surrounding parts, they are any thing but adequate. The knowledge of these facts furnished me with a clue to the most common cause of non-union; and, also, to the most common cause of failure after the operations which have been performed with a view to bring about a new action in the fracture. It is well known, that the same mechanical means are commonly used after the inflammation is re-established, as far as the state of the parts will allow, as are employed immediately subsequent to the injury; but, in some cases, they are much less efficient, as after the operation of cutting off the ends of the bone, &c. than they are in the first instance; for they cannot, with propriety, subsequent to these operations, be applied so tightly upon the limb as in a recent simple fracture. These means, as I have stated, allow the fractured ends to move frequently, which often prevents the union from taking place, when the fracture is recent; and, after the inflammation in an old fracture is re-created, by cutting off the ends of the bone, by rubbing them with caustic, or by any other means, the same cause will operate; and this is the grand secret why the usual plans of treating fractures of long standing are so seldom found successful.

Increased action necessary to the formation of callus.

In the treatment of fractures in this state, our business is to re-produce an inflammatory action in the situation of the fracture; and we do so upon a principle which I have elsewhere mentioned, and which seems to me as well founded as any one in surgery—that an action higher than the natural standard is necessary to the formation of callus. If this be allowed, it will be granted, that if a fracture does not unite, from a want of apposition and rest, during the continuance of the action which is set up immediately after the injury, that it will not unite at all till an action similar in kind, though it may differ in degree, is again set up in the fracture, either by Nature herself, or by the assistance of art.

Some of the means used do not produce it.

Some of the methods which have been resorted to, to produce this new inflammatory action, are not, in many instances, calculated to effect it; such as the application of a blister to the surface of the thigh, or the employment of a stimulating liniment gently rubbed upon the limb, when the fracture happens to be in the femur.

Others produce too much.

Some of them, on the contrary, excite an action much higher than is necessary for the formation of callus, as causticating the ends of the bone, or cutting them off. Both of these operations are usually followed by high inflammatory action; which is succeeded by a long suppurative process, and, generally, exfoliation of bone. During this process, bony granulations are formed, which occasionally coalesce and close up the breach of continuity. But the bony granulations are not formed during the high inflammatory action—they are produced, during the slow suppurative process, in the same manner as in compound fractures. The same might be observed of recent simple fractures—the osseous matter is not commonly deposited during the high action which comes on immediately subsequent to the injury. This assists in forming a bed for the new bone, which is deposited at a period when the high action has, in a great measure, subsided.

Effusion of lymph modified by the quantity of inflammation.

If the bones, by their frequent motion and displacement, keep up, for a long time, an action much beyond that which is natural, there will be in simple fractures, in consequence of the long continuance of this inflammation, a greater effusion of coagulable lymph, and also of bony matter; and, in compound fractures, there will be a larger supply of bony granulations.

Example.

If a man dislocates his ankle, a laceration of ligament and other structures must take place prior to the dislocation. This laceration will be followed by active inflammation, under which the different tissues will produce a secretion, modified, in some measure, by the degree of inflammation; but, it is probable that, in all of them, the action would run sufficiently high to occasion an effusion of coagulable lymph. But this effusion will, as I have said, differ in proportion, according to the degree of active inflammation. In all cases the action will probably be sufficiently high to occasion the effusion of this part of the blood, as the simple consequence of the injury; but, if we were to make the patient walk upon the limb, while the active inflammation exists, we should apply a mechanical irritant to a part already too much irritated; and, thus, increase the inflammation, and, consequently, the effusion of coagulable lymph; supposing the inflammation should not run so high as to destroy the vitality of the

Effusion of lymph and callus very great if inflammation be long continued.

irritated textures: so, if in fractures the action is high, and kept up considerably above the natural standard by frequent irritation, the effusion of coagulable lymph, all around the fracture, will be very great, and so will be the ultimate effusion of callus—sometimes so great as to unite the fractured ends of the bone at a considerable distance asunder, as is seen in *Plate* VI. *Fig.* 1. This takes place only under long continued inflammation. This kind of union we see principally in the bones of the lower animals, when no attempt is made to keep the fractured ends in apposition and at rest. The great irritation which is kept up, by the ends of the bone pricking and tearing the surrounding textures, is sufficient to account for the continuance of the inflammation, and the consequent great effusion which we observe.

The constitution of man less capable of bearing irritation than the lower animals.

If the fractured limbs of men were allowed to tumble about in the same way as those of the lower animals, from the moment the injury is sustained, the inflammation set up would probably go on to the destruction of life, man being less able to bear the effects of violence than the lower animals; but, in proportion to the powers of his constitution, he approaches to them in this particular. If the powers of his constitution be great, he has, like the lower animals, commonly less organic sensibility ; and, like them, he is better able to resist and repair the effects of injury, inflicted upon the soft parts by the broken ends of the bone, or any other cause.

Inflammation in strong persons soon subsides.

Hence we should infer, what we actually find, that if we have a fracture in the person of a strong man, and if we treat this fracture so as to prevent the ends of the bone from irritating the surrounding parts, the inflammation, arising from the accident, would soon subside. If the high action produced by the fracture, and the force which occasioned it, be immediately got rid of, and motion, such as would be sufficient to disturb the quietude of the fractured ends of the bone without irritating the contiguous parts, frequently take place, there would, in such persons, be great danger of tardy union. The coagulable lymph, which is thrown out under the first excitement, becomes sometimes formed, as I have said, into a sort of ligament, which supports and covers the ends of the bone ; so far as to prevent any material inconvenience from being felt in the soft parts. The excitability being, with difficulty, roused in such persons, Nature does not seem to trouble herself any further, and the fractured ends, thus connected, often form a preternatural joint, occasionally with a cavity, into which is poured a fluid, having the resemblance of synovia; which lubricates the parts, and facilitates their motion. In such persons, therefore, we should be less careful in reducing the inflammation than in others; and, in some instances, it might be even advisable to adopt means to support an action higher than natural, for a time, in order to facilitate the formation of callus.

In others, it is kept up longer under the same causes.

In other persons, in whom inflammation is easily excited, and easily kept up, re-union takes place more readily. In these, there is more inflammation and more tenderness, which continue longer; and, consequently, there is a greater effusion of coagulable lymph, and also of callus, than in those whose restorative powers are very great. *In the first class of persons, we must take care that the increased action does not subside too rapidly; in the second, we should be on our guard that it does not rise too high;* for, as I have said, the quantity of callus effused seems to keep pace with the inflammation, and the time it continues, provided the action is not too violent.

Increase of pain in the seat of fracture.

When a recent simple fracture goes on favourably, we observe that there is commonly more pain felt in the seat of injury, in adults, between the tenth and the sixteenth day, than during the previous four or five days. This pain the patient frequently compares to rheumatism, with an occasional start of the limb; and now and then, especially during sleep, a momentary lancinating pain in the fracture. All these symptoms indicate that there is increased action going on in the surrounding parts, and that this action, from some cause or other, is higher now than it had been for some days previous. This action, however does not require the interference of the surgeon. It indicates merely a salutary increase in the calibres and powers of the arteries, to enable them to perform an extraordinary labour. At this period the callus is forming; and the action of the arteries gradually subsides as the callus gets firm; but the tenderness round the fracture is sometimes felt, when the part is pressed, for two or three months after the bone is united. The tenderness, however, seldom continues so long, unless a large quantity of callus is effused.

The action, when the callus is forming,

Here we see that the action, which is observed when the callus is forming is above the above the natural action.

natural action; but that it is by no means an action which requires to be subdued by the assistance of art. *From these facts I inferred, that if an action, somewhat above the natural standard, could be produced in the ends of the bone, and the periosteum which covers them, in fractures of long standing, and, at the same time, all the causes of non-union be either removed or prevented, union by bone would be often easily effected—probably with almost as much facility, in the majority of cases, as when the fracture is recent.*

New action excited by pressure.

I had already possessed myself of means by which I could prevent what, I believe, was the principal cause of non-union in almost all the cases I have seen; *viz.* motion of the fractured ends. I therefore conceived, that I had only to excite the action of the parts, and perhaps to produce absorption of some adventitious deposite, in order to unite many of those which had been of long continuance. But, how were these desirable objects to be accomplished? It occurred to me, that they could not be so well effected by any other plan as by the influence of local pressure. Strong pressure produces inflammation; and, at the same time, absorption of the parts which are pressed upon. Pressure

I could readily produce and keep up, for an indefinite period; and, at the same time, maintain the parts in a state of quietude, by the contrivances already in my possession. I now wanted facts only to prove or disprove the validity of my reasoning.

I shall now proceed to mention the different means which I have resorted to, in order to bring about consolidation of the fractured ends in fractures of long standing, and the results to which I have arrived.

Influence of local Pressure and Rest in the Treatment of Fractures of long standing in the Humerus.

In cases of non-union in the humerus, where the bone is healthy and the fractured ends are not prevented from uniting by the intervention of any foreign body, I employ the apparatus which I invented for simple fractures of this bone. I apply this apparatus in the manner which I have directed for recent simple fractures of the upper arm, taking care, at the same time, to maintain the fractured surfaces in exact apposition.

Oblique.

When the bone is broken obliquely, this is done principally by padding the apparatus, as in recent fractures, according to the direction of the fracture, so that the fractured surfaces might be forced strongly together. In these cases the pressure operates principally in the tranverse direction.

Transverse.

When the bone is broken transversely, the fractured surfaces are forced together and maintained in close apposition, for the most part, by the operation of a short sling, or some other contrivance, which is made to act in a line with the long diameter of the bone.

Case.

As John F. Esq. M.P. was returning from Winchester, in a very dark night, about the 20th of July, 1822, the horses got off the road, and precipitated the carriage into a gravel-pit, nearly ten feet deep. He felt the left arm, just above the elbow, very much stunned by the fall; and, upon endeavouring to rub the part with the other hand, he discovered that the bone was broken. He immediately sent back to Winchester for his professional attendant. He was bled; and, in about three hours from the time of the accident, the fracture was reduced and put up in splints in the usual way.

The splints were re-adjusted on the third day, and afterwards every seven or eight days, till it was thought they might be safely removed; which was at the expiration of about six weeks. The limb at this time appeared perfectly straight. The arm felt weak, and he could not raise it from the side without great effort; but it was believed that the bone was united. After the splints were removed, he carried his arm in a cradle for a considerable period. In the month of November, he was thrown from his horse, but was not aware that the arm received the slightest injury from the fall. Some time after this, it began to feel much weaker than before, so that he was obliged to desist from attemping to carve or raise the arm from the side. After two or three days, he again recovered the use of the limb, in a slight degree, as before; but it had been for some time becoming gradually deformed, and, he observed that, in proportion as he attempted to use it, the deformity increased, and also the weakness, accompanied by a sensation of tightness over the fracture. In April, 1823, Mr. Segar, of Cheltenham, saw it, and expressed his belief that the bone was not united. This opinion was afterwards confirmed by Sir A. Cooper, Mr. Brodie, and myself.

On the 6th of June, 1823, in consequence of the recommendation of Sir Astley Cooper, I was requested to see this gentleman, in company with Mr. Brodie; and, upon examining the limb, I discovered a fracture extending obliquely downward and inward, a little below the middle of the bone. The limb could be readily bent at the fractured part, and was much deformed and shortened from the riding of the fragments. On the 7th of June, nearly *eleven months* after the accident, I applied the apparatus for the treatment of fractures of the humerus. By means of this, my first object was to remove the deformity as much as possible. This I fortunately succeeded in accomplishing in a few days, so far that the broken extremities overlapped only in a very slight degree, and they were now brought into tolerable apposition.

I conceived it probable that, in this case, there was a considerable quantity of ligamentous matter thrown out between the fractured ends; and that, after the lapse of so long a period, a more than ordinary degree of pressure might be required to produce its absorption. In order to save time, therefore, I immediately contrived an additional apparatus, furnished with a screw, by means of which I was enabled to produce any degree of pressure I thought requisite, in the longitudinal direction of the bone, and to regulate it with the greatest facility. The additional apparatus was first employed on the 17th of June, and strong pressure was kept up in the lateral as well as in the longitudinal direction. The pressure which I had previously employed produced some pain in the fracture, which now became severe, and continued so for a few days, and then gradually subsided.

July 26th, the apparatus was removed, and the limb was examined by Mr. Brodie, and myself; and, now, only a very slight degree of motion could be discovered in the fracture. The apparatus was re-applied; and, as the limb was so far recovered, we thought that Mr. F. might return to the country with impunity for the remainder of the period during which it was advisable that he should wear it. At the expiration of about three weeks more, it appeared that the apparatus might be, with propriety, discontinued. Having received instructions how to proceed, he left town with the intention to return at the end of this time; but, in consequence of some business which detained him, he did not come back till the 24th of August; when the limb was again examined, and the bone was found united.

When this gentleman had recovered the use of the limb, I requested him to allow me to ascertain the degree of shortening which remained; and, upon measuring from the point of the acromion over the outer condyle of the humerus to the edge of the ulna, I found that it was only a third of an inch shorter than the other.

Mr. F. possesses an excellent constitution, and enjoys good health, which was not impaired during the existence of the fracture.

Case.

John Nickling, aged twenty-seven, was admitted into Guy's Hospital, under Sir A. Cooper, July 17th, 1821. He had a transverse fracture of the right arm across the middle, occasioned by a blow from a heavy body. Liq. plumbi subac. dil. was applied for a week. The limb was then put up in the usual way with splints, extending from the elbow to the shoulder. He had no pain of consequence after the first week. The splints were removed at the end of six weeks from the time of the accident, and it was discovered that the bone was not united. All tenderness in the fracture had subsided, and the broken ends of the bone could be moved in all directions, without producing pain.

The fractured bone was now inclosed in a *leather case,* and the limb was placed in a tin trough, bent to a right angle, and made long enough to extend from the shoulder to the wrist; and he was ordered to support his arm with a sling. The straps which secured the leather case were occasionally buckled tighter, as the muscles of the limb wasted, in order to keep up strong pressure upon the fractured bone. This plan was continued till the 11th of May, 1822, nearly ten months, but without success. He still felt the yielding and motion in the fracture, which were evident when the limb was examined.

I was now present when Sir Astley Cooper examined the fracture, and told the man that the only chance left, was for him to submit to an operation. I requested Sir Astley to allow me to try the effect of the apparatus, which I have described for fractures of the humerus, before he proceeded to operate, to which he politely consented. The apparatus was applied and the man was directed to carry the arm in a short sling. The broken ends of the bone were pressed strongly together for *six weeks*; and, at the expiration of this time, the apparatus was taken off, and the bone was found firmly united and as straight as the other.

During the time he wore the apparatus, he had occasionally pains in the fracture, which he compared to those of rheumatism. These were at first rather severe, and the part felt sore; but both the pains and the soreness gradually subsided.

This case occurred in a strong man, whose health had always been good.

Case. March 11th, 1823.—James Game, a shoemaker, aged twenty-eight, was admitted into St. Thomas's Hospital, under Mr. Travers, having an old fracture of the humerus, just below the head. The accident was occasioned by a sudden jerk of the arm, in consequence of the thread giving way, as he was in the act of pulling it, when mending a boot. At first, he had common splints applied in the usual way; but it is evident that they had little power over the fracture, as he had always found the broken ends of the bone grate whenever he moved the body or the limb.

In this case the fracture had existed thirteen weeks. Mr. Travers politely called my attention to it, and allowed me to try to bring about a union by the same means which I had already found eminently successful. I examined the limb. The man could not move the arm from the side. The fractured part was sore; and crepitus was easily produced by rotating the lower part of the bone, while the head was fixed upon the scapula, by means of the fingers. The apparatus for fractures of the humerus was now applied, in the same manner as in the last case, and was worn for *thirty-two days,* and was then discontinued, as the bone had united.

The pressure kept up soon produced pain in the fracture, which was at first rather severe; but it subsided in the course of a few days.

This patient had not the appearance of a strong man; but he states, that his health had always been good; having never experienced any illness, except such slight occasional attacks as the strongest men are subject to.

Case.' John Ellis, æt. 22, a sailor, whose health had always been good, was admitted into St. Thomas's Hospital, on the 17th of July, 1827, under the care of Mr. Green, for the cure of a compound fracture of the right humerus. The fracture was occasioned by a severe blow from the handle of a crane, which struck him on the inner side of the arm, where the bone was exposed, and projected through the soft parts. He was brought to the Hospital immediately after the accident, where he was placed in bed, and had the limb laid upon a pillow; splints, extending from the shoulder to the elbow, having been previously applied, with a view to support the fractured parts.

Very little constitutional disturbance followed the accident. Suppuration was soon established; and he was allowed to sit up, and hang the limb by the side, about the tenth day. The wound healed in about seven weeks. After this, two small abscesses formed in succession near the elbow, which required daily attention for some time.

Sixteen weeks after the accident, it was found that the fractured ends had not united; though the original wound, and those occasioned by the abscesses, had been healed for a considerable period. The tenderness in the seat of fracture had so far subsided, that he could swing the arm freely without producing pain. The fractured part did not feel sore when handled; but there was slight tenderness experienced when the broken ends of the bone were strongly forced together.

The angular arm-splint was now applied, in such a manner as to meet the circumstances of the case. This soon produced pain in the fracture; but, in consequence of the tender state of the skin about the elbow, where the abscesses took place, it became slightly excoriated; which rendered it advisable to remove the instrument for a few days.

Nineteen weeks after the accident, the skin being sufficiently hardened, the apparatus was re-applied. The limb had now again lost all tenderness, and the fracture was quite loose. Three or four days after the re-application of the apparatus, pain again came on in the fracture; and was accompanied with an aching, and occasionally a shooting sensation, which, at times, was rather severe, but never continued long. The pain and tenderness gradually subsided, and the limb became quite easy in about a fortnight.

The apparatus was removed on the twenty-eighth day after its second application, and the bone was found united. In the course of a few days, he was desired to exercise the arm, in order to remove the stiffness which had taken place in the elbow-joint, which was produced by the abscesses and confinement; but it was feared that, in doing this, he injured the callus; for, in about ten days after the removal of the apparatus, he complained of pain in the limb at the seat of fracture, where, upon examination, slight motion was discovered. The apparatus was now again applied, and worn for thirty-one days, when its further use was discontinued, as consolidation of the bone had taken place.

The soft anchylosis of the elbow-joint was *now* removed, by the use of my screw apparatus, and friction—a plan of treatment which should always be resorted to in such cases, as there is danger of fracturing the callus, by the employment of irregular force.

This man is now following his usual avocations, with the limb as strong as it was before the accident.

Mr. Castledine, a strong healthy butcher, æt. 53, had a transverse fracture, situated in the middle third of the humerus, which was produced by a fall from a cart. He wore the split-deal splints, for about two months, and after this, my stiff elbow apparatus (not the angular apparatus for fractures of the humerus, as I presume was intended) very badly applied. Case.

About four months after the accident, he placed himself under my care, in consequence of the recommendation of Mr. Green. At this time, there was no pain produced by moving the fractured extremities upon one another; but he felt slight tenderness when the part was firmly pressed with the fingers. The state of the fracture did not allow of extensive, though very evident motion. The limb was perfectly useless. I applied the angular apparatus, as for non-union of the humerus of this description. Two days after the application of the apparatus, he experienced pain in the fracture, of the rheumatic kind, which was rather severe. On the seventh day after the application of the apparatus, the pain and tenderness had begun to subside, and had left him altogether at the end of a fortnight. The bone was found firmly united at the end of *three weeks,* when the use of the apparatus was discontinued, and he soon recovered the natural powers of the limb.

Case.

John Wright, æt. 29, a strong healthy man, came into St. Thomas's Hospital, under Mr. Green, for the cure of an ununited fracture of the humerus. The fracture had existed nearly four months; it was transverse, and not very loose. The common splints had been employed in another hospital, but without any benefit. On his admission into St. Thomas's Hospital, my apparatus was applied. He complained of pain in the fracture, of the rheumatic kind, for the first five days. This gradually subsided, and soon left him altogether. He wore the apparatus five weeks, when it was discontinued, as consolidation of the bone had taken place.

Case, by Mr. Brodie.

There is a case detailed in the Medical and Physical Journal for July, 1827, in which Mr. Brodie succeeded in bringing about consolidation of the bone by the influence of pressure and rest. The man was twenty-four years of age, and fractured his leg and arm at the same time. The fracture of the leg united, but no union could be produced in the arm. An attempt had been made to unite the bone by the use of a seton, which, however, only produced some thickening round the fracture. When the man entered St. George's Hospital, about four months after the seton was introduced, the fractured ends appeared to be united by ligament, which allowed of considerable motion. At the time the treatment by pressure and rest was adopted, the fracture had existed upwards of twelve months. By this plan osseous union was effected in three months, and the man's arm is now as strong and useful as the other.

Influence of local Pressure and Rest in the Treatment of Fractures of long standing in the Fore-arm.

Treatment.

In the treatment of non-union in the ulna and radius, exclusively of the olecranon and of the coronoid process, I have not hitherto found it necessary to employ any other means than the convex splints, which I invented for fractures of these bones; though I am disposed to think that, in some cases, additional means might be required.

Case. A gentleman, recommended to me by Mr. Green, fell, upwards of seven months before I saw him, with such violence as to produce a compound fracture of both bones of the forearm. The wounds were small, and healed by the first intention. He wore the common split-deal splints for a considerable time, and afterwards a leather case, buckled round the arm; but no union took place from the employment of these means.

When he came to consult me, the two bones were nearly approximated; and an obtuse angle had formed, projecting backward considerably, at the seat of fracture. The limb was very weak, so that he was unable to do any thing with it; and very perceptible motion could be felt in both bones.

I now applied my convex splints, in such a manner as to remove the deformity as much as possible; and, at the same time, to keep the fractured surfaces closely applied to each other. The splints were taken off at the end of *the seventh week;* and, on examining the limb, I found, that it had assumed nearly its natural appearance, but there was still an unnatural approximation of the ulna and radius.

The radius was firmly united, but I had some doubt, whether the union of the ulna was quite so firmly joined as would justify me in removing all mechanical support, though he was now able to use his arm freely; I therefore directed him to wear a guard for a short time, to protect the bones from injury; and not to endanger the union which had taken place by any violent exertion.

A female, æt. 74, applied to me for the cure of a disunited fracture of the radius, of about eight months' standing. She broke both bones of the fore-arm by a fall down stairs. The injury was treated by short splints, in the usual way. The splints were worn for one month. When I saw her the ulna was united, and the fractured ends of the radius were pressed in close against the ulna, and were overlapping, but had not united to the ulna nor to one another. The arm was very weak, and continued getting more so daily. **Case.**

When she came under my care I placed the arm in splints, in such a manner as to press the fractured ends together, and keep them at rest. The splints produced some pain and tenderness in the seat of fracture, which did not subside till about three weeks after their application.

This fracture united in seven weeks.

The Influence of Local Pressure and Rest in the Treatment of Fractures of long standing in the Femur.

Treatment.

The treatment of fractures of long standing in the thigh-bone must be modified according to the situation of the fracture.

In the upper-third.

If the fracture happens to be in the upper-third of the bone, the treatment I resort to is very similar to that which I have recommended in this work for recent fractures of this part.

In the cervix.

Should it be in the cervix, the only difference I have made consists in drawing the pelvis-strap closer; so that the fractured surfaces may be pressed more strongly together than is requisite in the management of recent fractures in this situation.

Case.

John Lucette, æt. 44, a labourer, employed in one of His Majesty's victualling yards, was admitted into St. Thomas's Hospital, having an old fracture of the neck of the thigh-bone, which had not been discovered before his admission.

He stated that he fell from a height of about four feet, and pitched upon the ground, so as to receive the principal force of the fall upon the left trochanter major. When he was lifted up, he was able to bear upon the limb, but not without considerable pain. He walked a few steps with assistance, but the pain occasioned by the effort obliged him to desist from proceeding further.

Upon examining the limb, after his admission into the hospital, it was observed that the *foot was not everted*, but *maintained its natural* position. The limb was retracted upwards of an inch, but could be readily brought down to its proper length by gentle extension. As soon as the extending force was discontinued, the limb became again retracted to its former situation. He had pain at the upper and inner part of the thigh, and the joint was tender when pressed upon. He had, also, some pain behind the trochanter major. He could bend the limb, and rotate it inward or outward; but not without increasing the pain. Crepitus was felt by Mr. Green, several other gentlemen, and myself, but not always readily.

He was placed upon my fracture-bed, on the 18th of January, in the manner I have directed for fractures of the cervix of this description, and the management of the case, by the kindness of Mr. Green, was confided to me.

Three or four days after he was placed upon the bed, he had an increased degree of pain in the groin, accompanied with an occasional start; which was sometimes sufficient to wake him. When he had been upon the fracture-bed about a month, a circumstance happened to him, in consequence of the ignorance of the nurse, which could scarcely have failed to disturb the fractured parts. He was again laid properly upon the fracture-bed, and continued upon it altogether eight weeks. At the end of this time, all pain and tenderness had subsided, and the limb was only *one-fourth of an inch* shorter than the other. He was now removed to a common bed; and, in the course of a few days, was allowed to bear upon the limb. As soon as he began to move the limb freely, the pain in the groin returned; but this was experienced especially when the flexors of the thigh were exerted. It was difficult to say what was the cause of this pain, as the length of the limb continued the same as it was when he was taken off the fracture-bed. He was kept in the hospital several weeks; and, during this time, was cupped twice or thrice, in the vicinity of the joint, with some relief. He improved very slowly in his walk while he was in the hospital; and as the limb did not become retracted, and as nothing satisfactory could be elicited as to the cause of the pain in the groin, he was discharged.

This man went from the hospital into the country, and I had not an opportunity of seeing him again for several months. He then walked with a crutch and stick; the limb had become retracted half an inch; he had still pain in the groin when he bore upon the limb, and the crepitus of fracture could again be felt.

Remarks.

This is a case of great importance. From its early history, which I have obtained from the gentleman who first saw the man, in company with two other surgeons, I have little doubt that it was, in the first instance, a case of fracture of the cervix femoris, unaccompanied with any considerable laceration of the surrounding parts. In a communication with which this gentleman has favoured me, he says, "I examined the limb half an hour after the accident. There was no mark of injury, neither eversion nor inversion of the foot; neither lengthening nor shortening of the limb; the trochanter major followed the movements of the limb, and not the least feeling or sound of crepitation was distinguished in the various movements of flexion, extension, and rotation. He complained loudly of pain; but more when the thigh was bent upon the body, or the limb extended, than when it was rotated. There was not the slightest discolouration or swelling; the inner ankles were in exact apposition; the man, while placed at full length on his back, was able, of himself, to draw up the limb, and bend it to a right angle with the body. He even stood upon the affected limb, and swang the other about like a pendulum." The gentleman to whom I am indebted for this account, and who had several times examined the limb, wrote to me, under the idea that there was no fracture. He says, "what more was wanting to come to the conclusion that there was no fracture of the neck of the thigh-bone?" So strongly was he convinced that there was "no fracture," that I doubt, from the tenor of his communications, whether he would have believed that a fracture had been discovered, if bony consolidation had taken place under the treatment that was adopted.

The early symptoms of this man's injury were similar to those which I have observed in others, who had fracture of the neck of the thigh-bone, where no laceration of consequence had occurred; and if he had been placed upon the fracture-bed before the limb became retracted I see no reason why strong union should not have taken place in his bone, as well as in Fitzgerald's, whose case I have related in a former part of this volume *(see page* 221*)*; but laceration of the surrounding parts having been produced, and so long a period suffered to elapse before any curative measures were had recourse to, the injury became one far more difficult to cure; and the man is now a burthen to his country, having been, I understand, made a pensioner for life, with a wife and several small children, without any other dependence for support.

This man's case was the first, which might be considered a case of non-union of the cervix femoris, that I had had to manage; and, consequently, experience had not taught me how long it might be necessary to confine a person so circumstanced, in order that a union might take place which, if not bony, might be sufficiently strong for the restoration of the natural power and the free motion of the limb. From the circumstance of the limb remaining of the same length, for several weeks, as when he was removed from the fracture-bed, we might infer that the uniting process had made considerable progress, notwithstanding the parts had been once, during his confinement, in all probability, much disturbed; and if he had continued upon the bed another month, the union might perhaps have been completed; or rendered strong enough to bear the weight of the body without yielding.

ase.

I have treated another case of non-union of the neck of the thigh-bone, in a female, which had existed about nine months, in the same manner. I think it probable that the fracture was, in this case, external to the orbicular ligament; but, as she had an affection of the chest, which prevented her from lying upon her back so long as I required, that degree of benefit which I hoped to obtain for her was not procured. She is a woman about forty years of age, and still continues to walk with crutches. This woman did not give the plan a fair trial, it would therefore be useless to relate the history of the case.

Below the trochanter minor, —oblique.

When the fracture is a little below the trochanter minor, and oblique, the splints which are placed upon the thigh must be made to act more powerfully upon the broken ends; so that their fractured surfaces may be pressed together strongly in the transverse direction.

Transverse.

If the fracture be transverse, a power should also be employed in addition to the splints, so as to force the fractured ends together, in a line with the long axis of the bone. This might be either a bag of shot, placed upon the knee, or a padded strap; which should be applied so as to exert its influence upon the knee and the pelvis. I am disposed, however, to give the bag of shot the preference, as it may be used with less inconvenience to the patient, in consequence of its pressure being more equal than when a strap is employed.

The subject of the following case was a patient of Mr. Wray's, Salisbury Square.

Case. Richard Springfield, æt. 39, whose health had always been good, slipped as he was coming down stairs, and falling backward, fractured his *right* thigh, immediately below the trochanter minor. He was carried to St. Bartholomew's Hospital, where he was placed upon one of Mr. Earle's beds, upon which he continued for a month. After this he was placed upon a common bed, and was removed from the hospital, eleven weeks after the accident, with the limb much deformed, and the fracture still disunited.

I found the fracture slightly oblique—the foot was everted, and a considerable angle was formed by the two fractured ends, which projected forward and overlapped. He felt slight pain in the injured part, when the limb was roughly handled; and the limb was weak and useless.

Sixteen weeks after the accident, he was placed by Mr. Wray and myself upon one of my mattresses, which was thrown over one of Mr. Earle's fracture beds; which I had had modified, so as to suit the circumstances of the case. This was done in order to save expense; as one of Mr. Earle's fracture-beds had been procured before I saw the patient. As he had

had a fracture of the opposite limb, which had united with shortening, it was thought advisable not to elongate the thigh, for the cure of which I was consulted. The foot was placed upright, and the whole limb being fixed, the fractured ends were made to bear strongly upon one another by the operation of a bag of shot placed upon the knee.

Slight pain came on in the fracture on the fifth day after the commencement of this treatment, and slowly increased till the twelfth day, when it was rather severe. It then gradually decreased, and had left him altogether before the twenty-fourth day.

The limb was examined at the end of the fourth week, and the bone was found united; but we considered it advisable to let him remain upon the fracture-bed another fortnight. At the end of the sixth week from the time he was placed upon the fracture-bed, he was removed from it, and placed upon a common bed. He was soon after allowed to bear upon the limb, the use of which he gradually recovered. The length of the two thighs was now equal; but as he had had a fracture of the *left* femur, we could not say decidedly whether any retraction had taken place in the right. He had, also, had a fracture of the left leg, which united, with the fractured ends overlapping, so that he now wears a high-heeled shoe upon the *left* foot, this limb being shorter than the other.

n the middle
lower thirds
—oblique.

Oblique fractures of long standing situated in the middle and lower thirds of the thigh, unite under the operation of the apparatus which I invented for recent simple fractures of the middle and lower thirds of the femur, &c.

Transverse.

If the fracture happens to be transverse, a strap carried from the pelvis to the knee will be sometimes required in addition; in order to keep up a proper degree of pressure in a line with the bone. The apparatus is applied in the manner which I have directed for recent simple fractures in the same situations. The straps, however, are kept tighter than is necessary in recent cases.

Case.

Nov. 14th, 1825, Sir Richard S——, Bart. was thrown from his horse, which, rolling over the thigh, fractured the bone near the middle. The fracture extended obliquely downward and outward. He was removed to his residence, which was about four miles from the place where the accident occurred; and the limb was laid upon the side, and the fracture treated according to the plan recommended by the late Mr. Pott. The limb was thus confined for six weeks; and, at the end of this time, when it was examined, the fractured ends were overlapping, but appeared to be united.

About ten weeks after the first accident, the union gave way, under the action of the muscles; and, on this occasion, the limb was placed in the bent position, half way between the side and heel, and confined by means of splints, extending from the pelvis to the knee, in the usual way. It was kept in this position for nine weeks, but the bone did not unite by the interposition of callus. After this it was attempted, under the direction of Sir Astley Cooper, to excite a new action in the part by pressing the broken portions together, by means of a strong leather case; according to the plan recommended by Dr. Inglis. During this treatment, the ends of the bone were suffered to rub upon one another; as Sir R. was suffered to exercise himself with the assistance of crutches, though he was not allowed to bear upon the limb. This plan occasioned great pain and tenderness in the fracture, but it had not the effect of producing consolidation of the bone.

Sixty-six weeks after the second accident, Sir R. applied to me, and upon examining the limb, I found that the fracture was situated about the middle of the bone, and extended in a direction downward and outward; and that the fractured ends were overlapping rather *more than two inches and a half.* The surfaces of the bone which were lying the nearest together, were united by a soft substance which did not allow of any great extent of motion. He had lost all pain in the part, and was able to bear, and even walk upon the limb, though the thigh could be easily bent so as to produce an angle at the seat of fracture, projecting in any direction; and Sir R. observed that the fracture was getting looser daily.

At the time this gentleman called upon me, he was under the care of Mr. Brodie, who, however, had seen him only a few times. I had an interview with Mr. Brodie, and we determined to employ the apparatus which I had invented, for the treatment of simple fractures of the middle and lower thirds of the thigh-bone, fractures of the leg, and other purposes.

On the 30th of April, 1827, I applied this apparatus, in the presence of Mr. Brodie, Mr. Copeland, and others.

The apparatus produced a slight pain in the fracture about the third day, which came on occasionally, and was at its height about the sixth day; but, even at this time, the pain was neither severe nor constant.

Sir R. was confined in the horizontal position; but, in the course of a few days after the application of the apparatus, he was allowed to turn his limb from the heel to the side, and *vice versâ*, at pleasure. This liberty rendered the confinement less irksome than he would otherwise probably have experienced it.

At the end of the sixth week, Mr. Brodie, Mr. Copeland, and myself, examined the limb as far as we considered it prudent, at this time, and were of opinion that it was going on well; in fact, it was now so far recovered, that we could not discover any motion in the situation of the fracture. The limb was again confined as before; and we determined to let it remain in the apparatus for four weeks longer, in order that the union might become strong. At the expiration of this time, making *ten weeks* from the period when it was first applied, the apparatus was removed; and we had the happiness to find that the bone was united firmly, and the limb upwards of *three-fourths of an inch longer than it was when this treatment was commenced.*

The natural powers of the limb were soon restored, and he is now able to follow his hounds with as much ease as any of his friends.

The result of this case could not fail to excite great pleasure in the minds of all those to whom Sir Richard is personally known.

Remarks.

It might be asked, why we did not endeavour to extend the limb, so as to make its length equal to that of the other, before we attempted to produce union by the interposition of bone. Mr. Brodie, Mr. Copeland, and myself, had some conversation upon this subject, and came to the conclusion, that it would not be advisable to extend it much; for we considered that, as the ligamentous union was strong, and not loose, we should not be able to bring down the limb to its natural length; and if we failed to do so, it appeared to us that we should lose strength of union, in proportion as we might gain in the length of the limb. We, therefore, determined to apply the apparatus, so as to bring the limb as nearly to its proper form as circumstances would admit; and, at all events, if possible, to produce consolidation of the fractured ends, without endeavouring to obtain any greater degree of elongation than the then state of the soft union would allow.

A gentleman in the City, aged 55, whom I attended, with Mr. Dendy, of Stamford Street, in getting from a stage-coach, fell, and broke his thigh at the lower part of the middle third. He was conveyed to an hotel, and treated with the common short splints in the usual way; but no union of the fracture took place while they were employed. Case.

I saw this gentleman, for the first time, about eleven weeks after the accident, in company with Mr. Dendy. The fracture extended through the bone in a direction downward and inward, and the fractured extremities were connected only by loose adhesions.

The limb was much deformed, there being an angle in the thigh, at the seat of fracture, projecting greatly to the outer side, while the foot was twisted inwards. He was unable to raise the limb—in short, it was perfectly useless.

The apparatus was applied, but not with that nicety which it admits of under ordinary circumstances, as the gentleman had an anchylosis of the knee-joint, the result of a disease with which he was afflicted at an early part of his life; and he had, also, a sore in the integuments, on the side of the inner condyle, apparently produced by the pressure of the splints which he had been wearing. In consequence of this sore, the pressure necessary to bring the upper and lower portions of the bone into their natural line could not be so effectually exerted. However, much was done in the accomplishment of this desirable object.

On the removal of the apparatus, two months after it was first applied, I found the bone was united, with the foot in its proper position, and the thigh-bone only slightly curved to the outer side.

Remarks. This gentleman, possessing an irritable constitution, was very restless during the cure, which probably delayed the accomplishment of the union many days.

It might be observed that, previous to the accident, the injured limb was shorter than the other, the thigh-bone was curved outward, and the foot everted; so that he walked with the inner side of the foot turned forwards; though he now walks with the foot in its proper position, and the thigh-bone is less deformed than it was previous to the accident.

March 16th, 1823.—Richard Holdway, aged twenty-nine, was admitted into St. Thomas's Hospital, under Mr. Travers, having a transverse fracture of the thigh, which extended through the bone a little above the condyles. The third day after his admission, he was attacked with cholera morbus, which continued for a week, and reduced him so much, that he was not able to assist himself in the least, when he wanted to be placed upon the bed-pan. Case.

On the 22d, Mr. Travers, with his usual politeness, offered me the superintendence of the treatment of the fracture. The short splints, which had been applied, were now taken off, and there was no swelling nor any appearance of inflammation in the limb. Assisted by his then apprentice, Mr. Macmerdo, I applied my apparatus for fractures, &c. of the lower extremities, in the manner I have directed that it should be used in such cases; and requested him to have his bed made every two or three days, and to have the limb moved *passively* as often as he wished. This mode of treatment was followed for two months, but without any appearance of union.

May 22.—The apparatus was now applied so as to press the broken extremities of the bone closely together; but the pressure kept up was but slight; and, in order to ascertain whether the motion, which was, from time to time, given to the limb, had any effect in preventing the union, I directed the man to remain quietly in bed in one position, and ordered him not to have his bed made above once in three weeks. This plan was persevered in till the 23d of July, making a period of four months from the time the apparatus was first applied; but neither was there at this time any appearance of ossific inflammation having been set up.

An additional apparatus was now employed, in order to press the broken ends of the bone strongly together. He soon felt pain in the fracture after this, which he compared to the pains of rheumatism. This pain was greater sometimes than others, but was never severe. On the 28th of August, the fracture was again examined by Mr. Travers and myself, and it was at this time found much firmer. The apparatus, being old, had now got out of order, and, in consequence of some delay, it was not re-applied till the 11th of September; but, in the mean time, great care was taken to keep the limb quiet. October 14th, the apparatus was removed, and the bone was found united.

Remarks.

In this case we see the effect which a debilitating disease has in retarding the union of a fracture; and that when the action, which appears to be necessary to the production of callus, is once so entirely subdued as in this instance, it does not readily become re-established. Though I had previously treated three cases in the same way with the happiest results, I had some doubt whether, in consequence of inattention, the motion which was, from time to time, given to the limb, during the first two months, was at all influential in preventing the union; but this doubt was removed by the subsequent treatment, in which, notwithstanding the limb was kept quiet in one position for two months, no ossific action was set up till the strong pressure was applied. It appears to me, therefore, that the want of union in this case may be fairly attributed to the effects of the disordered and debilitated state of the system, from which he recovered but slowly; and that the action necessary to the production of callus was brought about by keeping the fractured surfaces strongly pressed together, as in the preceding case. Strong pressure was applied for sixty-nine days, and the man recovered without the least deformity in the limb.

The Influence of Local Pressure and Rest in the Management of Fractures of long standing in the Leg.

Treatment.

I employ, in the treatment of these cases, the apparatus which I invented for simple fractures of the leg, &c. This is a simplification of the apparatus which I have recommended for simple fractures of the *leg*, &c. *(See* page 418.*)*

Oblique.

If the fracture be oblique, the only difference in the application, from the mode in which the apparatus is employed in recent simple fractures, consists in forcing the fractured ends more strongly together in a line with the transverse diameter of the bone, and in keeping the foot-board so that it might not produce shortening of the limb.

Transverse.

When the fracture is transverse, the foot-board should be placed upon the leg-piece, so that the distance between it and the knee of the apparatus should be rather less than the distance between the sole of the foot and the ham, when the foot is brought to form a right angle with the leg. By this arrangement, it will be seen that, when the limb is placed upon the apparatus, and the foot-board brought up so as to form a right angle with the leg-piece, the back of the thigh, at the ham, will not be quite in contact with the pad covering the thigh-part of the apparatus. The limb being firmly fixed in the apparatus, with the foot and leg placed so as to form a right angle, and the thigh as I have stated, the surgeon has it in his power to force the fractured ends together very strongly, by means of the strap which passes round the thigh, over the apparatus, close against the knee; the foot bearing, at the same time, upon the foot-board, so that the lower portion of the fractured bone cannot recede at all from the pressure made upon it by the upper. In these cases the inside of the wooden sole of the shoe should be padded.

I think fractures of long standing in the leg are more easily united than those which occur in any other situation.

A lady received a blow from the heel of a horse, as she was on horseback, on the lower part of her stirrup-leg. The force fractured the fibula, about two inches and a half above its lower extremity, and the tibia an inch and half above the point of the inner malleolus. She applied to her surgeon in the country, who placed her in the horizontal position, employed short splints, and did every-thing he thought advisable. Eight weeks after the accident, finding she had no power over the limb, she came to town to consult Sir Astley Cooper, and, by his recommendation, requested my attendance. The fibula was, at this time, united close to the side of the tibia, and the leg deformed in consequence; but distinct crepitus and preternatural motion were still observable in the fractured part of the tibia.

The machine was applied; and, in five weeks and three days, the tibia, also, was found firmly united.

During the cure, the lady walked about with the assistance of crutches, carrying the limb in a sling; received company; or took an airing in her carriage at pleasure.

As Mr. Wallack, the actor, was travelling from New York to Philadelphia, the coach was upset, and he was thrown from the coach-box into the road. The body of the coach, carrying a heavy load, fell upon his leg, and produced a fracture of both bones, through the upper and middle thirds. The upper fracture was simple, the lower compound. The compound fracture was not attended with much laceration of the integuments. There were two wounds which led to the fractured ends of the tibia, each of which was about half an inch long. Splints were applied to the limb, and he was conveyed to Brunswick, New Jersey, a distance of about fifteen miles, where he was put in bed, and the limb placed upon the outer side. The tension that came on in the limb was great; but the constitutional symptoms which accompanied it, were not severe. **Case.**

In a little more than seven weeks after the accident, it was considered that the bones were consolidated; but neither of the wounds was yet healed. In the course of another week, it was discovered that the lower fracture of the tibia was not united. A scale of bone, about an inch long, and half an inch wide, was now taken away, and he was again confined to bed, with the limb lying, between splints, upon the side.

After the dead bone was extracted, the wounds healed readily, and then various means were resorted to, under the direction of some of the most eminent surgeons in America, with a view to bring about union of the bone. Among these were friction and tight bandaging, accompanied with confinement in the horizontal position. After these means had been tried without benefit, he had splints applied very tightly upon the limb, and he was directed to leave his bed, and move about with the assistance of crutches; but this mode of treatment was equally unsuccessful, and he states that, while he was trying it, he frequently felt the broken ends of the bone grate upon each other.

Finding all the efforts that had been made to produce union of the bone were unattended with any beneficial result, he came to London for further surgical assistance, and I saw him shortly after his arrival, which was upwards of seven months after the accident, in company with Sir Astley Cooper and Mr. Triple.

He could, at this time, suffer the foot to rest upon the floor, so as to support the superincumbent weight of the thigh which was thrown upon it as he sat in a chair; but no additional weight could be borne. The only fracture which remained disunited, was that which extended through the middle third of the tibia. This was oblique. Motion and crepitus were easily produced in the fracture. The foot was extended, the ancle fixed, and the limb was weak and useless.

I applied my apparatus for fractures, &c. of the lower extremities, in such a manner as to press the fractured surfaces closely together; and directed him to take an airing every day with the assistance of his crutches, or in his gig. Severe rheumatic pain came on in the fracture the following night, but subsided altogether in a few days. This mode of treatment was persevered in for *forty days*; and, at the end of this period, the bone was found united. He the ladder, the cask overpowered him and fell. When the cask had fallen about three feet, the keen edge of the end pitched upon the ladder and upon his leg, snapped the ladder, and, as I am informed by the surgeon who first saw him, produced a simple fracture of both bones of the leg. He was conveyed in a coach, about a mile, to one of our hospitals, where he was put in bed, and his leg was laid upon the outer side on a pillow. An evaporating lotion was applied to the limb, which soon became very much swelled and very painful. Six days after, the tension was considered to be sufficiently reduced to allow of the application of the common splints. He was kept in bed *three weeks* after the application of the splints, with the limb lying upon the heel. At the end of *this time*, he was suffered to *leave his bed;* as his surgeon conceived, that the *common splints* were sufficient to prevent motion from taking place in the fracture. He moved about with the assistance of crutches, wearing the splints, and carrying the limb in a sling. At the end of the fifth week, it was discovered that the fracture was not united, and that the leg was much deformed. A bandage was now applied tightly round the leg; over this, splints of split deal, so as to incase the leg; and over the splints of split deal, a pair of common leg splints. He was now confined to bed again for three weeks, with the limb lying upon the side. At the end of the three weeks he was again allowed to get up and move about as before; with the limb confined by the splints, as last applied. He continued *this* plan for three weeks, making eleven from the time of the accident. At the expiration of this time, the splints were taken off, and it was found that the tibia was still disunited. He was confined to bed a third time, and had a stimulating liniment rubbed upon the leg every day, the limb lying upon the side, without splints. This plan was continued till his admission into St. Thomas's Hospital, but without any beneficial effect.

Upwards of fifteen weeks after the accident, and two or three days after he was admitted into St. Thomas's Hospital, Mr. Green politely offered me the superintendency of the treatment. The apparatus was applied so as to press the broken ends of the bone firmly together. He was furnished with a sling, and directed to walk about every day as much as he pleased. At the expiration of *thirty-three days*, during which, he occasionally felt rheumatic pains in the fracture, which, however, were never severe, the apparatus was taken off, and the bone was found united.

He informed me, that he never felt any sensation of motion in the fracture after the apparatus was first adjusted, though he had noticed that it frequently took place while he was wearing the common splints, notwithstanding they were applied so tight as to give him great pain.

Ballard was a strong man, possessing a vigorous constitution. He may be said to have always enjoyed good health, and he states, that whenever he received a flesh wound, it healed rapidly.

Remarks.

This man was admitted into the hospital to which I have alluded, about the same time with another, 55 years of age, who had, also, a fracture of both bones of the leg equally severe. The latter was placed under my care, and was up *on the third day* after the accident. He continued to leave his bed daily, and to walk about the ward, with the assistance of crutches, till the 24th day, when the apparatus was taken off, as the bones had united. At the end of the fifth week he was able to walk the ward without crutch or stick. This man's case forms a strong contrast to Ballard's, who was kept in bed till the end of the third week. It shows the rapidity with which union takes place under the use of my apparatus, when a patient is allowed to be up. Ballard's case is a lesson for surgeons who fancy that a patient, with fracture of both bones of the leg, might be permitted to leave his bed with impunity before the fracture is united, when the limb is supported only by the splints which are commonly employed. If Ballard had been treated in the same way as the other man, I have no doubt that the bones would have united by the intervention of callus, within three weeks, during which he was confined to bed, under the treatment adopted, without its accomplishment.

ase. J. Van W——, Esq. aged twenty-eight, in endeavouring to quell the Negroes in Demerara, on the 18th August, 1823, was wounded by a musket-shot, which passed through the leg, about six inches below the knee, and produced a fracture of both bones. He was carried home, and when the limb was examined, it was found that the tibia projected about an inch. The surgeon, not being able to reduce the bone into its proper situation, sawed off the projecting portion. He was then placed in bed, with the limb lying upon the outer side, and such means were resorted to as were thought advisable to preserve the leg; and he states, he was attended "with the utmost care."

High inflammation came on, and was followed by profuse suppuration. He remained in bed, in this position, *three months and nine days*, without once being permitted to have it made, for fear of disturbing the fracture. During this time, the discharge continued very great, and he became much reduced.

In December, he had so far recovered, as to suffer himself to be wheeled about the room on a sofa. At the latter part of January, 1824, he began to use crutches; and in the middle of February, he went out in a gig. Some bits of bone were taken away during his confinement, and the wounds were healed. After the lapse of seven months, finding the limb entirely useless, he resolved to embark for England.

About thirty-eight weeks after the accident, he arrived in London, and, on the 6th of May, called on me, from the recommendation of Sir Astley Cooper, who had informed him that the bone was not united. I examined the leg, and found a loose fracture of the tibia, extending obliquely downward and backward, accompanied with riding of the fractured ends. The fibula was united, and the part which had been fractured was surrounded with a large quantity of callus. Whenever he moved the leg, he felt motion in the fracture. The limb was very weak. He could suffer it to rest upon the floor, as he sat in a chair, but any additional weight thrown upon the leg gave him pain in the fracture.

May 9th. I applied the apparatus first, in such a manner as to bring the broken ends of the bone as nearly as possible into their proper situation; and having done this, as far as the state of the parts would allow, I regulated it, as in the other cases, so as to press them closely together, and to prevent any motion from taking place between the fractured surfaces. He was furnished with a sling, and desired to go about with the assistance of crutches, or in any easy spring vehicle, as much as he pleased, taking care not to exert the muscles of the limb.

He soon found considerable pain in the fracture, which subsided in a few days; and, having never been in London before, he now took every advantage of the liberty I gave him ; but he states that he never felt the least motion in the fracture after the apparatus was applied. At the expiration of *thirty-three days*, I removed the apparatus, and found the bone was firmly united. On the 25th of June, he was able to walk about the house, with the assistance of a cane only, without experiencing the least sensation of weakness or pain in the fracture.

Before he left England, which was in about seven weeks after I first saw him, inflammation was set up in the soft parts, a little distance from the part of the bone that had been fractured, which led me to suspect, that some spiculæ of bone were lodged in that situation. This, I was induced to believe, might be the case, though they had not been previously productive of any mischief which led to a suspicion of their existence. He walked about considerably—sometimes the distance of a mile. This, I conceived, might cause them to irritate and produce inflammation ; which, it was to be expected, would run on to suppuration, preparatory to their discharge. In a letter which he favoured me with, from France, dated 2d August, he states that these have since come away.

This gentleman's health has always been such as we see in persons who possess strong constitutions; and he is certainly one of the most healthy-looking men I ever saw.

Remarks. As my patients with non-union in the leg were permitted to be about, it may occur to some of my readers, that friction was produced between the broken extremities of the bone, and that ossific inflammation was set up, in the same manner as when a patient, with short splints tightly bound round the leg, is ordered to bear upon the limb; but this was not the case. The ossific inflammation was set up by the pressure, not by the combination of pressure and friction, which happens when the patient bears upon the limb, secured only by short splints in the usual way. The practice of directing patients to walk upon the limb, secured by short spints only, but seldom succeeds; and I suspect that the principal cause of failure is the frequent production of motion in the fracture—an evil which is effectually got over by the use of the apparatus which I have employed, as may be seen by referring to the cases.

Some surgeons may conceive that motion between the divided surfaces does not impede the progress of union; but this opinion, I believe, is fallacious. We must have a certain action in the part, which may be brought about by the immediate effects of the injury, or by pressure; but, in addition to this action, local rest is required, in order to insure a favourable result.

The cases I have related satisfactorily prove, to my mind, that we have no reason to apprehend the occurrence of non-union from the practice I have recommended in the treatment of recent simple fractures of the leg; and I presume it will scarcely be argued, that an apparatus, which is capable of effecting a cure in cases of long standing, is, at the same time, likely to occasion such cases, when employed in the treatment of recent simple fractures, provided it be properly applied. If this be granted, and I think it cannot be denied, I must assume, that the mere existence of a fracture in the leg will be seldom sufficient to authorize us to confine a patient to bed, till the consolidation of the bone is effected. He may be permitted to leave his bed a few days after the accident, and will thus be saved from the irksomeness of remaining so long in one position as is necessary for the union of the bones, and from the debilitating effects which long confinement in bed often produces upon the constitution.

General remarks.

In detailing the symptoms which occurred after the application of the apparatuses which I employ, I have said that pain was felt in the fracture in the course of a few days, which, in the different cases, differed very much in degree. In some of them it amounted only to a slight aching pain, accompanied with, now and then, a lancinating sensation in the fracture; but the inconvenience felt in all the cases varied, more or less, in the course of the day; and I am not aware that, in any one of them, it was at any period sufficiently severe to affect the pulse—certainly not so as to produce any noticeable fever.

I have related seventeen cases of non-union, in sixteen of which I have myself succeeded in producing consolidation of the bone; namely,

In the Humerus, 6.

1 Fracture had existed (about)..	11 months,—	united in (about)	7 weeks.
2 Ditto..........	10 months,—	ditto	6 weeks.
3 Ditto..........	13 weeks,—	ditto	32 days.
4 Ditto..........	19 weeks,	ditto (1st appl^{n})....	28 days.
		ditto (2^{d} appl^{n})....	31 days.
5 Ditto..........	16 weeks,—	ditto	21 days.
6 Ditto..........	16 weeks,—	ditto	35 days.

In the Fore-arm, 2.	1 Fracture had existed	7 months,—united in	7 weeks.
	2 Ditto.. (about)	8 months,—ditto	7 weeks.
In the Femur below the Neck, 4.	1 Fracture had existed	16 weeks,—united in	4 weeks.
	2 Ditto	66 weeks,—ditto	10 weeks.
	3 Ditto...........	11 weeks,—ditto	2 months.
	4 Ditto... (about)	19 weeks,—ditto.. (about)	10 weeks.
In the tibia, 4.	1 Fracture had existed	8 weeks,—united in	38 days.
	2 Ditto..........	7 months—ditto.........	40 days.
	3 Ditto..........	15 weeks,—ditto.........	33 days.
	4 Ditto..........	38 weeks,—ditto........	33 days.

The above cases were published in the First Edition of my Observations on Fractures. I have since successfully treated other cases which have come under my care at various periods after the injury was inflicted; enough, however, have been related, to show the importance of the plans which I have advised; I need not, therefore, take up the time of my readers, by inserting these, as their histories do not differ in any material point from those already mentioned.

Why, it might be asked, did the bones, in all these cases not unite while the fractures were in the recent state? I should say, with one exception, because the treatment adopted, and which is commonly recommended, did not prevent the fractured ends from moving upon each other. In some of these cases an increased action had been created in the fracture, and had again subsided before they came under my care —why did the fracture, in these instances, not unite during its continuance? For the reason which I have just mentioned. Why did they all unite with so much facility when the plans of treatment I have advised were resorted to? Because, under their influence, an action above the natural standard was produced in the fractured parts, and during its continuance they were kept at rest.

Treatment of Fractures of long standing which do not admit of being united under the Influence of Pressure and Rest alone.

Disease in the bone.

When a fractured bone continues disunited, in consequence of disease existing in its structure, the local treatment will depend upon the situation of the fracture and the condition of the limb. In some instances, as where the bone is in a state of necrosis, amputation might be advisable.

Interposition of a foreign body.

When a bone is prevented from uniting by the interposition of a foreign body between the fractured surfaces, it will be proper to remove it by an operation, and afterwards treat the case as a compound fracture; taking care to keep the parts quiet, and in contact, during the granulating process. If the fractured ends should not unite during the healing process, the influence of pressure and rest may be resorted to, in order to complete the cure.

Dead bone.

It often happens, after compound fractures, that portions of the fractured ends exfoliate; and, sometimes, the exfoliation takes place in situations where it prevents consolidation of the broken ends till the dead bone is removed. This should not be attempted till it is separated by the absorbents from the living parts. The period which Nature takes for this varies exceedingly in different cases. Sometimes it lies loose in the wound, in the course of six weeks or two months after the accident; at others, even several years elapse before it is all thrown off. I am not acquainted with any application which materially assists the process of exfoliation, and therefore it appears to me, that the surgeon can do little more, locally, till the dead bone is separated, than keep the parts at rest, and guard the fractured limb from injury; taking care, at the same time, to support the constitution. If the fracture happens to be in the arm or in the leg, the patient need not be confined constantly to bed. During the exfoliating process, when the state of the soft parts will allow, he may leave his bed; but, if they become very much irritated, by hanging the limb down, it will be proper to assume the horizontal posture again for a time. If the fracture happens to be in the femur, the patient must be constantly confined to bed, as the fractured parts cannot, as far as I know, be sufficiently supported to allow the patient to move about with safety. As soon as the dead bone is separated, it should be taken away, and the case treated in the same manner as after the removal of any other body, which would have the effect of keeping the fractured surfaces asunder.

Some of these cases are very tedious, and, consequently, require much patience on the part of the sufferer as well as the surgeon.

Preternatural capsule.

There is another state of the fractured parts which, as far as my experience goes, is not likely to admit of being favourably treated by the influence of local pressure and rest alone; namely, where the broken extremities are held together by a preternatural capsule, containing a fluid resembling synovia.

Case in St. Thomas's H pital.

A man was admitted into St. Thomas's Hospital, under Mr. Green, about six months after the accident, having a fracture in the middle-third of the humerus, which was very loose, so much so, that the portions of the bone could be bent upon one another with almost as much facility as the fore-arm upon the humerus. All pain had subsided, and he did not experience pain or tenderness when the injured parts were pressed upon or moved. The apparatus was applied, in order to see what effect it would produce. It occasioned considerable pain in the part in a few hours after it was applied, which was so severe as to interrupt his rest, in a great degree, for several nights, and then gradually subsided. I examined the limb at the expiration of a fortnight, but it did not appear that the least good had been produced. As the parts had not become at all consolidated, notwithstanding the high excitement occasioned, it was the opinion of Mr. Green and myself, that it would be useless to continue this mode of treatment any longer, and, as the man declined to have any operation performed, he left the hospital.

Before this man was admitted, we had had the experience of one unsuccessful case, which was the first that I had met with; the particulars of which I shall now relate, as it seems to me deserving of particular attention.

Case.

Malcolm M'Lean, a strong healthy sailor, aged 36, was admitted into St. Thomas's Hospital, March 11th, 1827, under the care of Mr. Green, having a very loose oblique fracture of the upper part of the middle third of the thigh, which had existed *twenty-four weeks.* The fracture was occasioned by a fall upon deck from a height of about sixty feet. The limb soon became much swollen and very painful. There being no medical man on board, ten days elapsed, after the occurrence of the accident, before any surgical assistance could be procured. At the end of this time, the ship arrived at a port in Montevidio, where he was received into one of the Portuguese hospitals. During the time he was in that hospital, nothing was employed to support the limb but short splints, extending from the pelvis to the knee. These proved very inadequate to answer the purposes for which they were applied; motion and displacement being produced, almost as readily as if the case had been left to nature.

The pain and swelling, however, which came on immediately after the accident, gradually subsided. Ten weeks after the accident, when he removed from the hospital to return to England, the pain had left him, and he had very little tumefaction in the limb; but they were re-produced, in a slighter degree, by his exertion to get to the ship, which he accomplished with the assistance of crutches, the limb being surrounded with short splints as before.

On the 19th of March, twenty-five weeks after the accident occurred, and a week after the man's admission into St. Thomas's Hospital, Mr. Green politely offered me the management of the case. Upon attentively examining the limb, we found the fracture extending obliquely downward and outward, through the upper part of the middle third of the bone. The fractured ends were very loosely connected, so that they could be freely moved in all directions. The upper portion was bent upon the pelvis, and the lower portion was retracted upwards of two inches and a half along the inner side of the upper. By gentle extension the limb could be brought to nearly its natural length; but, the moment the extending force was discontinued, the lower part of the bone was again retracted to the situation which it previously occupied on the inner side of the pelvic portion. Thus, the extent of motion which the fractured ends had upon one another in the longitudinal direction, was about two inches and a half. The fractured part felt somewhat tender when firmly pressed with the fingers; but scarcely any pain was produced by freely moving the broken extremities upon one another. The lower portion could be carried out of a natural line with the upper, and almost bent upon it, without producing any inconvenience calculated to give rise to complaint on the part of the patient.

Treatment by pressure and rest.

As I had not had a case of non-union of the thigh so loose, I was unable to say how far the line of treatment which I had found successful in other cases, would prove beneficial in this. I doubted whether a preternatural capsule, containing a fluid resembling synovia, had not formed here, as I find such capsules form more speedily when the fractured extremities are loosely held together, than when the connecting medium prevents any great extent of motion; but, as I had not had any case in which I had not succeeded, I was unable to say, whether the means I adopted to bring about union of the bone by the interposition of callus, would, or would not be sufficient to produce union after the formation of a preternatural capsule. The most prudent mode of proceeding, therefore, appeared to be, to have recourse, in the first instance, to that plan of treatment which, in my hands, had never yet failed. I mentioned my feelings to Mr. Green, and finding that he came to the conclusion to which I had arrived, assisted by his dresser, Mr. Wickham, I applied the apparatus which I invented for simple fractures of the middle and lower thirds of the thigh, &c. in such a manner as to *retain the limb of its proper length, and to press the fractured surfaces strongly together.*

The apparatus had the effect of producing pain in the fracture in a few hours after it was applied. The pain increased and became severe on the third day, accompanied with painful startings of the limb. The pain, however, though severe, was not of a description to produce any marked effect upon the system. On the fourth day, the pain had much subsided. The straps were now tightened, which increased the pain in the fracture; but it soon became moderate. He wore the apparatus for about ten weeks, suffering more or less pain in the fracture during the whole period, with the exception of two or three days previous to its being removed; but, notwithstanding the existence of the symptoms which precede union, *viz.* pain and tenderness in the fracture, were much more severe than in any former case I had witnessed, the only apparent benefit derived, was a closer confinement of the fractured ends, by the adhesion of the soft parts that had taken place around them, during the continuance of the excitement which the operation of the apparatus had produced.

Introduction of the seton.

The plan of treatment by pressure and rest having failed to produce union, the consideration now was, what should next be done in order to effect it. Mr. Green concurred with me in the opinion, that the probable cause of failure was the existence of a preternatural capsule, containing a fluid resembling synovia; and that it would be advisable to destroy its integrity by the introduction of a seton, which would, at the same time, have the effect of exciting a high action between the ends of the bone, and in the neighbouring soft parts. This operation was determined upon as the most simple of those which appeared likely to be advantageous when had recourse to, in conjunction with any means calculated to support the fractured ends in apposition and at rest.

The man was placed upon one of my fracture-beds, and the thigh again extended to its proper length, where it was confined in the bent position. He was brought to the edge of the bed, with the limb kept extended to its natural length, over the middle and lower planes of the bedstead, as before; and, while he lay in this position, Mr. Green introduced a long and somewhat curved seton-needle, armed with silk, through the thigh, directing it between the fractured extremities of the bone. The needle was introduced at the outer and back part of the thigh, and brought out anteriorly without difficulty. The needle being removed, the ends of the silk were left hanging, and covered only with a piece of simple dressing. The man was now shifted back to the middle of the bed, without suffering any retraction of the limb to take place; and, when confined in that situation, by fixing the foot and the pelvis, a splint was applied along the outer side of the limb, and secured in such a manner as to press the fractured surfaces gently together, without pressing at all upon the soft parts surrounding the fracture.

The next day, the limb was rather swollen round the seton, from inflammation, and the pulse was increased in frequency. Suppuration took place in two or three days, and the constitutional disturbance became rather severe. The openings soon discharged a large quantity of pus daily; and this, and the constitutional disturbance kept up by the local irritation produced by the seton, had the effect of reducing his system greatly.

About a fortnight after the introduction of the seton, it was observed that the matter began to burrow beneath the fascia, presenting itself at the upper and inner part of the thigh. This affected his constitution still more; so much, indeed, was the man's health disturbed, that it would not have been safe to allow the seton to remain in any longer; and it was accordingly removed, on the *nineteenth day* after its introduction.

The seton had produced a great deal of thickening of the soft parts surrounding the fracture, such as has been often mistaken for callus; and, when the fractured ends were pressed together strongly, he experienced severe pain in the part. The matter was daily evacuated from the upper part of the thigh, where it lay very deep; and it was found that the contents of the abscess gradually diminished in quantity, and ultimately disappeared through the openings made by the seton-needle.

After the seton was withdrawn, the constitution soon began to rally under the influence of tonic medicines and a generous diet; so that he was sufficiently recovered, in a few days, to feel himself able to take the common food of the hospital. Great care was taken to keep the fractured surfaces in close apposition and at rest during the suppurative process; but, as it was necessary, for some time, to move the splint daily, in order to evacuate the matter which had burrowed along the outer side of the limb, for about two inches beneath the vastus externus, as well as that which had collected on the inner side, it will be seen that the parts could not be kept in that perfect state of quietude which it was desirable at this time to maintain. The matter could not be evacuated without producing motion of the fractured extremities of the bone.

At the expiration of about five weeks from the time the seton was introduced, the discharge from the wound had ceased; but there still remained considerable tenderness in the fracture, and thickening of the surrounding parts. Three additional splints were now applied, and the whole secured round the limb as he lay upon the fracture-bed, in the same manner that I have recommended for fractures of the thigh, just below the trochanter minor; care being taken to press the fractured surfaces strongly together, and to maintain them in tight apposition and at rest.

These splints were thus continued upon the limb for a month; and, at the expiration of this period, making nine weeks from the time the seton was introduced, they were removed, and the limb examined, but no osseous union had taken place. The limb was rendered stiffer by the thickening of the soft parts, which was the only difference the seton had produced.

The operation of cutting down upon the ends of the bones.

The man was now removed to a common bed; and, some time afterwards, it was determined, in consultation, to cut down upon the fractured ends, with a view to ascertain, if possible, the cause which still prevented the process of bony union from being excited; and then to act in that manner, which, upon exposing them, may appear most advisable.

The man was again placed upon the fracture-bed, with the limbs in the bent position; in order to secure to the operator a perfect command over the muscles of the thigh. A semicircular incision was made by Mr. Green, which was commenced about the middle of the rectus, and then carried round through the belly of the vastus externus. The flap was dissected back, and the fractured end of the upper portion of the bone brought into view. Upon clearing away the muscles, it was seen that the two broken extremities of the bone were connected together by a thick dense capsule, resembling the capsule of the hip-joint, the inner surfaces of which were perfectly smooth and shining. The integrity of this capsule was destroyed, by removing a portion of it from the upper fragment; but, in consequence of the difficulty which was experienced in getting at the fractured end of the lower portion, which, as has been said, lay on the inner side of the upper, *it was left covered with the ligamentous matter.* In removing about half an inch of the fractured end of the upper fragment, which was done by one of Mr. Hey's saws, in order to give room, it was found that the bone had become soft and spongy at this part, apparently from interstitial absorption. From the manner in which the ends of the bone lay, it was evident that the lower portion could not be cleared of the ligamentous deposite which covered it, without enlarging the wound in the soft parts—a proceeding which, in the opinion of Mr. Green, and some other surgeons, appeared objectionable.

Two or three small vessels were secured, and the cut surfaces were suffered to fall together, where they were lightly confined by a couple of adhesive straps; and a poultice was then applied over the wound. The pelvis was confined by the strap, attached to the upper plane of the fracture-bedstead, upon which he was placed previous to the operation, and the foot was secured to the foot-board. The thigh was left free from splints and bandages, being preserved of its proper length by the unyielding planes of the bedstead.

The man did not suffer much from the operation, except when the finger was passed into the preternatural capsule, between the oblique surfaces of the fractured ends; which was done in order to ascertain its extent. The capsule possessed a high degree of sensibility, so much so, that when the finger was passed into it, the man could not help crying out. He said, the pain produced by the incision through the integuments and muscles was nothing, compared to that which he experienced when the *inner surface* of the capsule was pressed with the finger. He was a considerable time under the operation, and felt chilly when it was over; but he soon recovered his natural heat after he was covered with the bed-clothes. He passed a good night, and so free was he from constitutional disturbance, that he was put upon full diet the day after the operation. The limb became moderately swollen at the seat of the operation, and suppuration was established on the third day. The greater part of the cut surfaces adhered, however, so that there was only a small opening, at the upper and outer part of the wound, for the matter to escape. Some of the matter burrowed towards the upper and inner part of the thigh, where an abscess formed, and made its way to the surface, producing some, but not severe, excitement of the system. The matter was evacuated by two punctures, made within a few days of each other; and his health soon became strong.

On the tenth day, a splint was padded, and applied along the outer side of the limb, so as, if possible, to produce absorption of the ligament which covered the fractured surfaces, by forcing them together; but this was done in such a manner as not to press upon the wound, which could be easily dressed without moving the splint. He experienced a great deal of tenderness in the fracture for the first month after the operation, especially when the slightest motion was given to the limb.

Seven weeks after the operation I removed the splint and examined the limb, but no union of the bone had taken place. The punctures made for the evacuation of the matter of the abscess had now healed, but there still remained a considerable portion of the wound over the fracture to cicatrize.

Thinking it possible that the split cloth, which had been placed round the limb over the splint, had not been sufficiently powerful in its action to produce absorption of the ligamentous matter which covered the ends of the bone, I applied a splint on the inner side of the limb, long enough to extend from the knee to within a very short distance of the fracture; and having re-applied the outer splint as before, I surrounded the limb with the web of a tourniquet, which passed over the splint just below the fracture. This plan enabled me to force the ends of the bone very strongly together by screwing the tourniquet. The action of the tourniquet did not, however, produce any material excitement in the fracture. There was pain occasionally, but it was only slight and transient.

The action of the tourniquet was kept up, as powerfully as the man could bear it, for a fortnight; making nine weeks from the time of the operation. It was now removed; and, on examining the limb, it was found that no good whatever had resulted from the operation, or the treatment by which it was followed.

The limb was perfectly useless; and, seeing that all our endeavours to bring about union of the bone had failed, the poor fellow was now desirous of losing it, which was accordingly agreed to.

The operation was performed in a very masterly, and somewhat novel manner, by Mr. Green. The bone was taken off immediately above the preternatural joint, and about half an inch below the trochanter minor.

Examination of the bone.

At the time of the operation, which was performed with a view to remove the preternatural capsule, a bit of the fractured end of the upper portion was removed; and it was observed that the bone was soft and spongy, apparently from interstitial absorption. This, however, was not the case higher up. Where the bone was sawed off in amputating, it was found perfectly healthy. Though the integrity of the preternatural joint had been destroyed, it was now again complete. The greater part of it was nearly the thickness of the capsule of the hip-joint, but, at one part, it was thin, like the capsule of the shoulder-joint; the capsule was accidentally torn at this part with the finger, and the inner side was seen smooth, and had very much the appearance of synovial membrane, being moist and shining. The ends of the bone were rounded, and, where they came in contact, they were flattened and covered with a dense fibrous structure, very similar in appearance to the intervertebral substance when divided transversely, but especially that part of it which is found half-way between the centre and circumference.

The subject of the above case possesses a strong constitution, and has always had good health, in the common acceptation of the term; his constitution strongly resists local irritation, and when it suffers in consequence of great injury, it soon rallies after the local mischief is subdued.

Remarks.

In this case, we might fairly attribute the want of union, in the recent stage, to the use of means which are inadequate to keep the fractured extremities in apposition and at rest. I regard the loss of this man's limb as a sacrifice to the treatment adopted in the recent state of the fracture—a sacrifice which, I am sorry to say, is often repeated, and will continue to be so, as long as the common means are generally employed.

In this man we see that a preternatural capsule had formed in six months, which is a fact, in corroboration of the opinion which I am disposed to entertain; *viz.* that, where the fracture is very loose, and the powers of the constitution strong, preternatural capsules form much sooner, than where the ends of the bone are so connected, as to allow of their having but little motion upon one another.

We have here, also, an example of the inadequacy of the treatment by local pressure and rest, which I have introduced, where the fractured ends of the bone are held together by a preternatural capsule. It is worthy of remark, however, that though this treatment does not appear likely to succeed in such cases, in the cases which I have related, it produced symptoms far more severe, though similar in kind, to those which preceded the uniting process in all the instances where this plan was resorted to with success.

It will be perceived, that the plan of treatment *first* adopted in M'Lean's case above detailed, *commonly* succeeds in producing union, though there is, now and then, an instance in which, when resorted to alone, it will be ineffectual. The converse of this, however, obtains with all the other plans with which I am acquainted. Bony union has been by them effected very rarely; and, even in these rare instances, commonly not till after several months of severe suffering.

In M'Lean's case, it has been observed, that very high inflammatory action, produced by the introduction of a seton, was not sufficient to give rise to the uniting process, notwithstanding the most effectual means were used to keep the fractured extremities in tight apposition, and (as soon as the parts would allow) in a perfect state of quietude.

After this plan had failed, the integrity of the capsule was destroyed by the removal of a portion of it from one of the fractured ends, and though the assistance of apposition, pressure and rest were again secured, osseous union was not produced.

Upon attentively considering the state of the parts in this case, in conjunction with others of a similar kind, I am induced to believe, that in all *very loose* fractures of long standing, after trying, for a short time, the plan by pressure and rest without success, it would be better to cut down upon the fractured ends of the bone, and remove with the knife any ligamentous matter with which they may be covered; and then to wash the ends of the bone with some stimulating fluid, calculated to produce active inflammation; or to destroy the connecting medium by the application of caustic. After either of these operations has been performed, we might anticipate, that bony granulations

PLATE I.

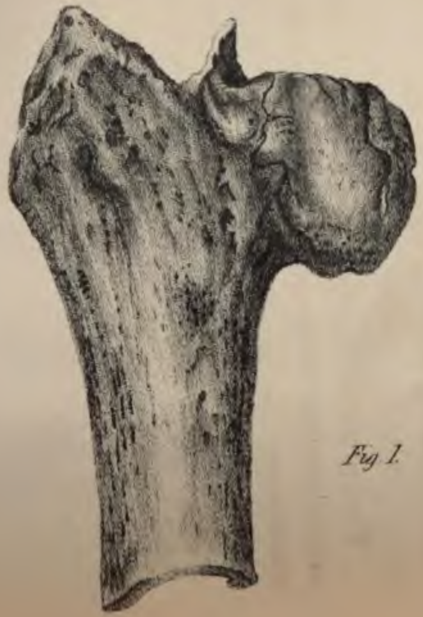


Fig. 1.

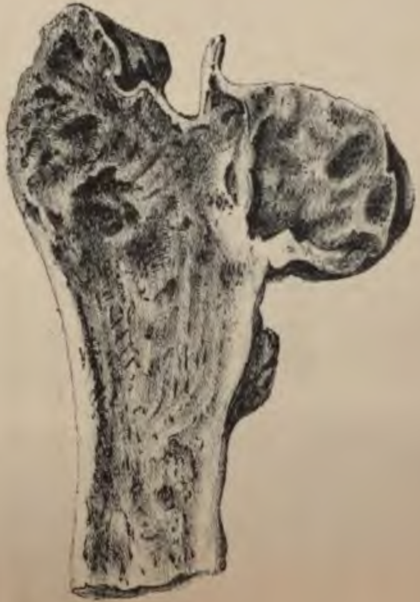


Fig. 2.

PLATE II.

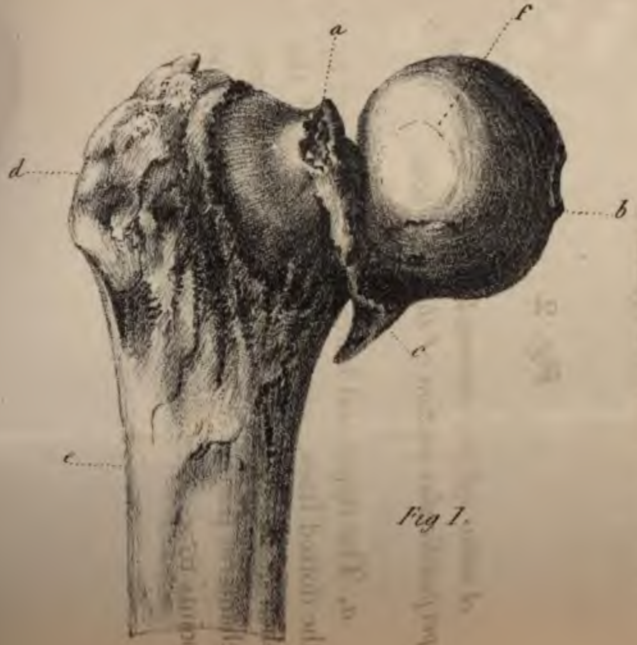


Fig 1.

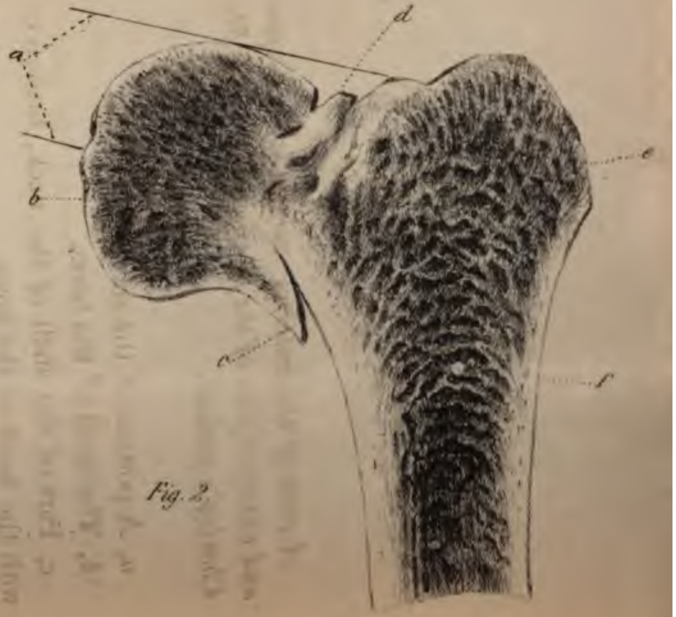


Fig. 2.

PLATE II.

Fig. 1.

A view of the anterior surface of the upper and external part of the femur, taken from Mr. Chorley's patient.

a, A portion of the shortened cervix.

b, The head of the bone.

c, Part of the shell of the neck, broken off with the head of the bone.

d, The trochanter major.

e, The shaft of the bone.

f, A mark on the head, showing the attachment of an adventitious ligament.

Fig. 2.

A view of the internal surface, made by a perpendicular section of the same bone.

a, The upper and lower lines, connected by the dotted lines, point out the situation of the shell of the upper and lower surface of the trochanteral portion of the neck. The lower line points to a portion of the lower surface of the shell of the neck imbedded in the head of the bone. This part of the cervix probably maintains its natural direction and density.

b, The head of the bone excavated, and receiving a part of the trochanteral portion of the neck.

c, A part of the shell of the neck broken off with the head. This was apparently united, before the accident, with that part which is pointed out by the lower line, *a*, and with it formed the natural oblique line of the lower surface of the neck.

d, The callus, by which consolidation is effected, partly cancellated.

e, The trochanter major.

f, The shaft of the bone.

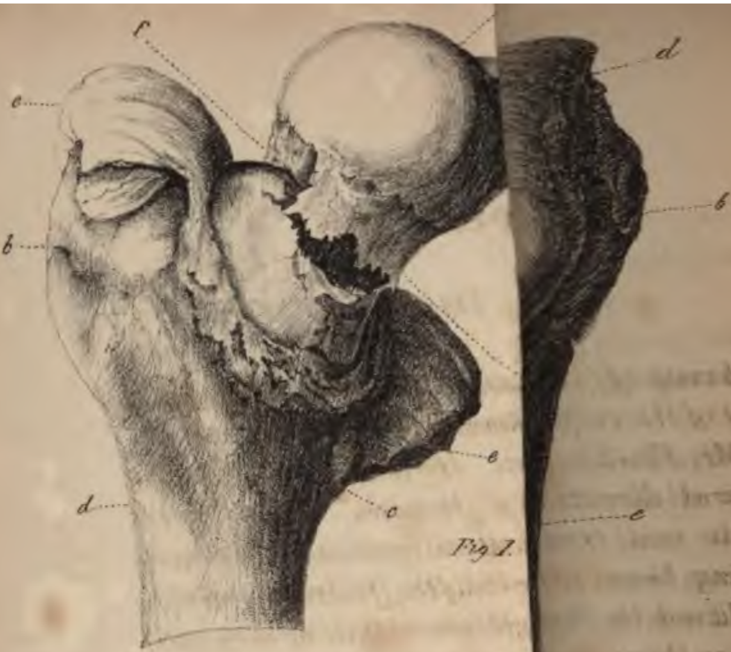


Fig. 1.

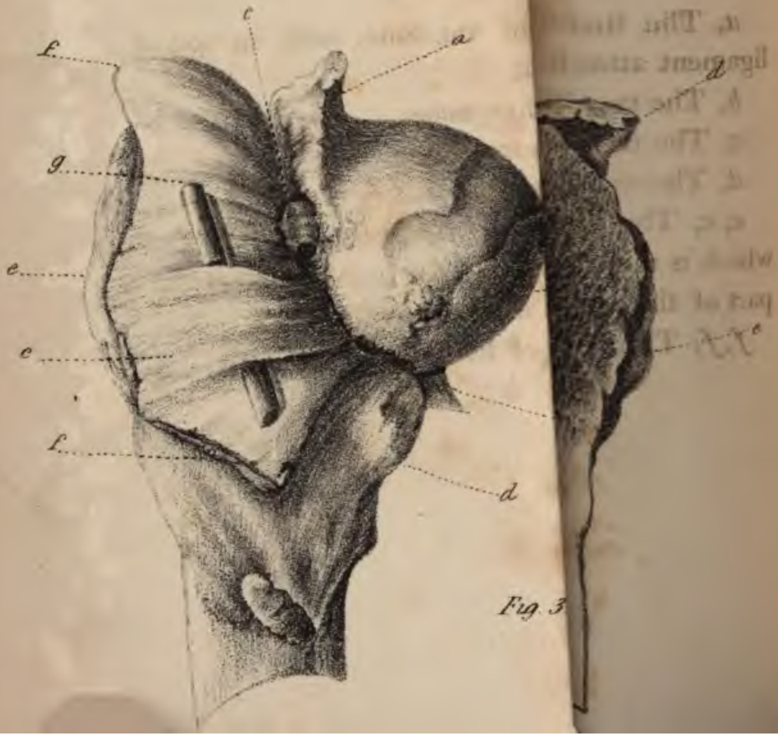


Fig. 3

PLATE III.

Fig. 1.

A view of the anterior surface of the upper part of the right *femur, taken from the subject, of Mr. Field's case. In this figure is seen the natural direction of the neck. A part of the pelvic and trochanteral portions of the neck having been absorbed, the fractured surfaces could not be brought into contact at every part, but as there is a portion of the investing membranes left entire, the proper position of the head could not be mistaken.*

a, The head of the bone, with its round ligament attached.

b, The trochanter major.

c, The trochanter minor.

d, The shaft of the bone.

e, *e*, The capsular ligament; a portion of which is removed, in order to show the anterior part of the neck more effectually.

f, *f*, The line of fracture.

Fig. 2.

A view of the anterior surface of the upper part of the left *femur, taken from the same subject.*

a, The head of the bone.

b, The trochanter major.

c, A part of the trochanteral portion of the neck.

d, The capsular ligament turned back.

e, The shaft of the bone.

f, The neck rendered smooth by the action of the tendon of the psoas magnus and iliacus internus.

Fig. 3.

A view of the upper and posterior part of the same bone.

a, Part of the shell of the upper surface of the cervix.

b, The head of the bone.

c, c, c, Strong adventitious ligaments running from the inner surface of the capsule to the pelvic portion of the bone, into which they are firmly inserted.

d, The trochanter minor.

e, The trochanter major.

f, f, The capsular ligament cut and turned back over the trochanter major.

g, A bit of bougie separating a portion of adventitious ligament from the capsule of the joint.

Fig. 4.

Represents the internal surface of the same bone, made by a perpendicular section of the wet preparation through the head, neck, large trochanter, and capsular ligament.

a, The shell of the neck at the upper and lower part of the trochanteral portion, pointed out by the uninterrupted lines. These parts appear to be of their usual density, and show the direction and thickness of the cervix.

b, The head of the bone, excavated and receiving, near its centre, the lower part of the shell of the neck. The head is seen depressed towards the trochanter minor, *c*, which it nearly touches, and is firmly united to the trochanteral portion of the neck by osseous matter which has become cancellated.

d, *d*, The capsular ligament opened and turned back over the trochanter major and minor.

e, The trochanter major.

f, Strong ligamentous band running from the neck of the bone, close to its junction with the head, to the capsular ligament, into which it was inserted.

g, *g*, The apparent line of fracture.

PLATE IV.

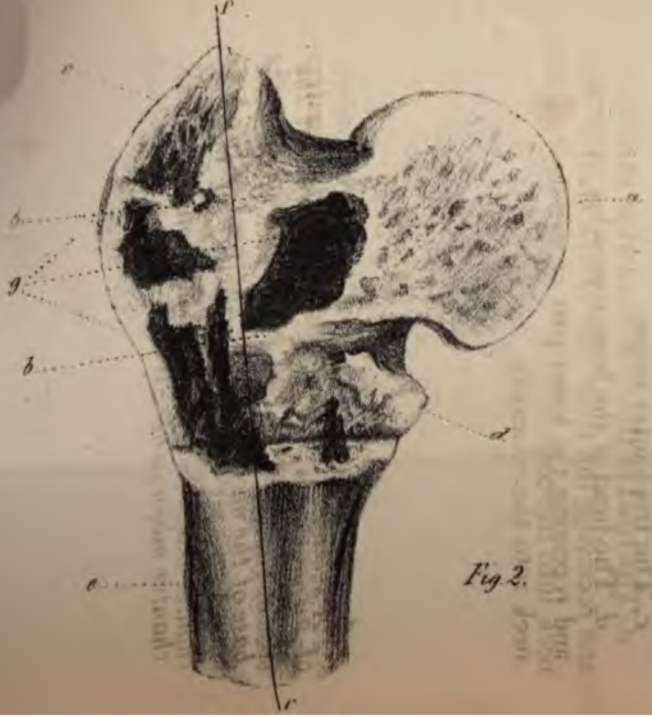


Fig. 2.

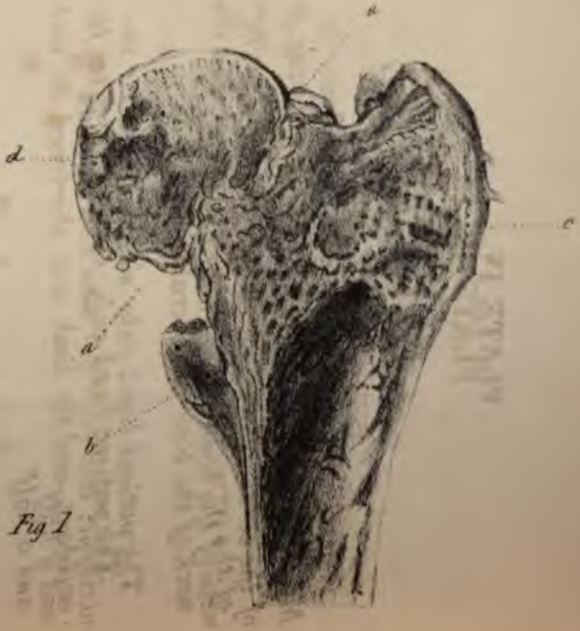


Fig. 1

PLATE IV.

Fig. 1.

A section of the upper part of a femur in Mr. Langstaff's collection, showing a fracture of the cervix closely united by ligament, and the neck of the bone considerably absorbed.

The patient lived only six months after the accident, and the limb was shortened one inch and a half.

a, a, The line of union.
b, The trochanter minor.
c, The trochanter major.
d, The head of the bone somewhat excavated and receiving the lower part of the shell of the neck into the concavity.

Fig. 2.

A section of the head, neck, and trochanters of a femur, which had been fractured at the base of the neck; showing the neck of the bone driven into the cancelled structure of the trochanter major, where it is firmly united by bone.

This preparation was in Mr. Green's collection, who allowed me to take the drawing.

a, The head of the bone.

b, *b*, The shell of the neck.

c, The trochanter major.

d, The trochanter minor.

e, An undivided portion of the shaft of the bone.

f, *f*, The line of union.

g, Holes in the cancellated structure of the neck and trochanter major.

PLATE V.

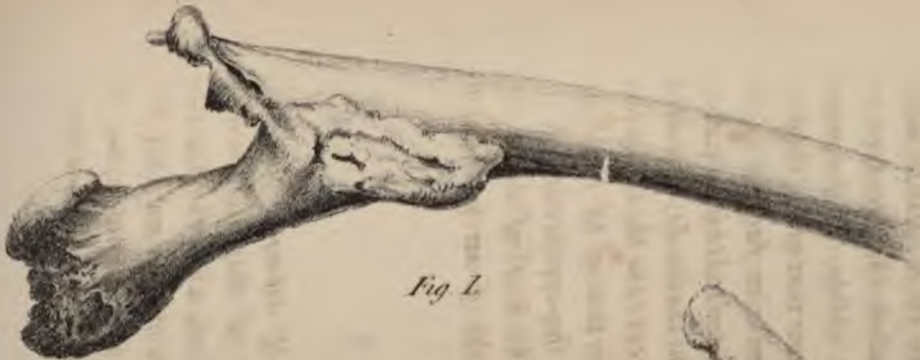


Fig. 1.

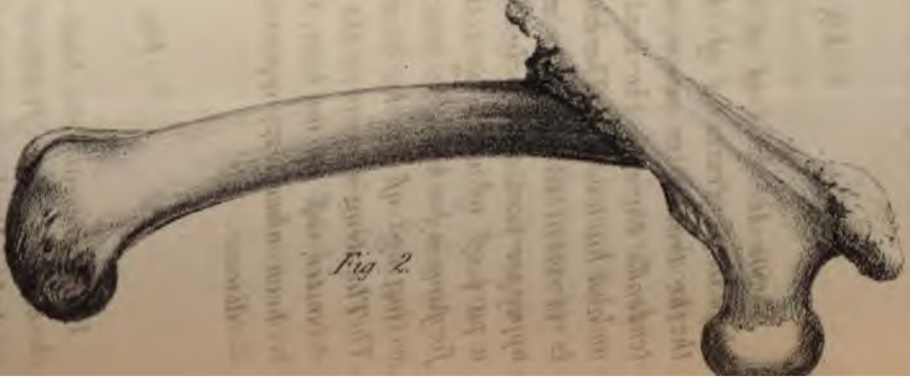


Fig. 2.

PLATE V.

Fig. 1.

Shews the kind of deformity which takes place in fractures of the thigh, a little below the trochanter minor, when the fracture extends through the bone obliquely, downward and backward. The lower portion of the bone is retracted along the anterior surface of the upper portion, and firmly united to it by callus; a part of which is seen curiously deposited, forming a hook-like process over the sharp projecting end of the lower portion of the bone. The drawing represents the appearance of the outer side of the bone, the head of which had been absorbed, apparently, from scrophulous disease.

Fig. 2.

Represents the kind of deformity which is observed after fractures of the thigh, a little below the trochanter minor, when the fracture extends through the bone downward and forward. The upper portion is bent upon the pelvis and abducted; and the lower portion is *retracted beneath it, and to the outer side, where it is firmly united by callus near the trochanter minor.*

The preparation from which the figures in this plate were taken, was also in Mr. Green's collection.

PLATE VI.

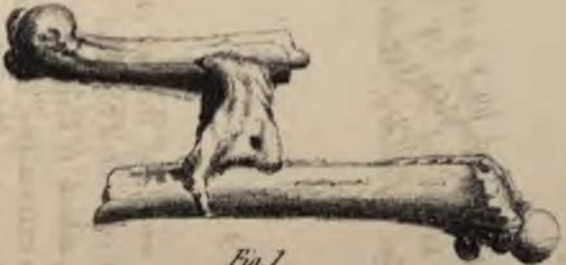


Fig. 1

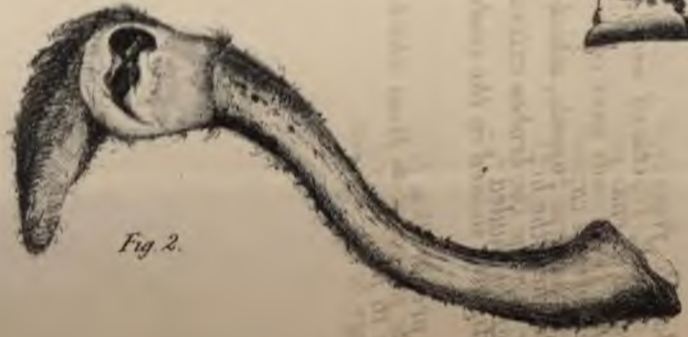


Fig. 2.

PLATE VI.

Fig. 1.

The humerus of a duck united by a cross bar of bone, presented to me by Mr. T. M. Lane, Surgeon to the Eye Infirmary, Madras, E. I. C. S.

Fig. 2.

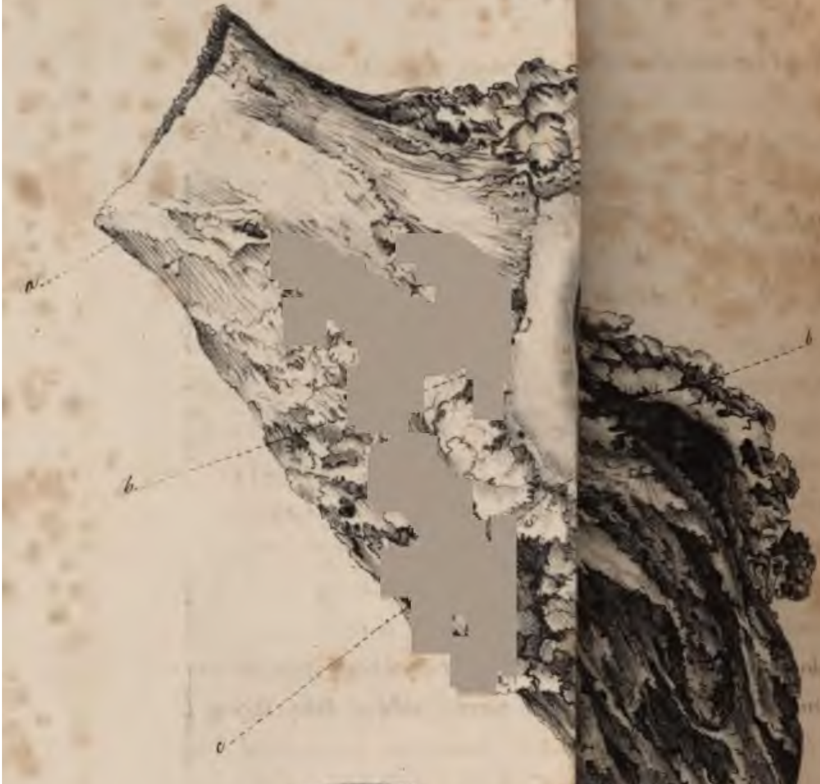
A clavicle fractured near the sternal end. The fractured ends were connected together by a preternatural capsule, which is laid open, in order to shew the broken extremities, which are seen lightly shaded in the centre of the cavity.

The preparation from which this was taken belongs to Mr. Green.

PLATE VII.

'ontains representations of parts taken from ung horse, which was rendered useless by injury received in the hip-joint about fifteen ths before it was killed. On inspection, neck of the femur was found fractured e to the head. The fracture was of the e kind, allowing the fractured surfaces to e freely upon one another. The prepara- n is important inasmuch as it shows that irritation occasioned by friction has caused same changes to be produced in the upper ge of the acetabulum, the fractured surface the pelvic portion, and also in the fractured rface of the trochanteral portion of the fe- ur; namely, absorption and interstitial de- sition, by which the surfaces are rendered nooth and, in some parts, dense like ivory. he ivory appearance, however, presented by e altered edge of the acetabulum, is more niversal than that of either of the portions f the femur. This might be attributed to he difference in the original structure of he bone, which is much less cancellated at this art than the neck of the femur. The ivory ppearance observed in the opposing surfaces f the pelvic and trochanteral portions of the femur is much the same; if there be any dif-

Fig. 1.



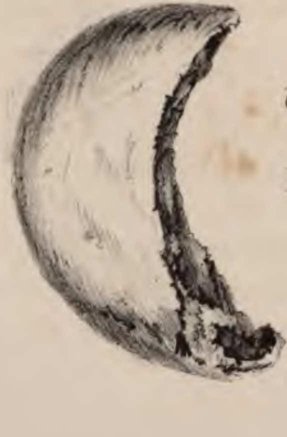


Fig. 2.

PLATE VII.

Contains representations of parts taken from a young horse, which was rendered useless by an injury received in the hip-joint about fifteen months before it was killed. On inspection, the neck of the femur was found fractured close to the head. The fracture was of the loose kind, allowing the fractured surfaces to move freely upon one another. The preparation is important inasmuch as it shows that the irritation occasioned by friction has caused the same changes to be produced in the upper edge of the acetabulum, the fractured surface of the pelvic portion, and also in the fractured surface of the trochanteral portion of the femur; namely, absorption and interstitial deposition, by which the surfaces are rendered smooth and, in some parts, dense like ivory. The ivory appearance, however, presented by the altered edge of the acetabulum, is more universal than that of either of the portions of the femur. This might be attributed to the difference in the original structure of the bone, which is much less cancellated at this part than the neck of the femur. The ivory appearance observed in the opposing surfaces of the pelvic and trochanteral portions of the femur is much the same; if there be any dif-

ference it is in favour of the pelvic *portion. The drawings were taken after the bones were freed from the soft parts by maceration.*

Fig. 1.

A view of a portion of the pelvis, having a large quantity of osseous matter deposited in irregular masses around the acetabulum.

a, The sawn end of the ilium.
b, The altered edge of the acetabulum.
c, The head of the femur resting in the acetabulum.
d, The sawn end of the ischium.

Fig. 2.

Represents the remaining portion of the head of the femur much hollowed out by absorption.

Fig. 3.

A view of the trochanteral portion of the femur covered round the base of the neck with a large quantity of new bone very irregularly deposited.

a, The trochanter major.
b, The remaining portion of the cervix.
c, A portion of the shaft of the bone.